the OIL AND GAS JOURNAL

JANUARY 14, 1957

The A.B.C.'s of

HYDRAULIC FRACTURING

In which Joe learns about . . .

- PAYOUTS
- PRESSURES
- WELL BEHAVIOR
- SIZE OF TREATMENTS
- POWER NEEDED
- FRACTURE FAILURE

17-page section starts on p. 91

What's Behind the Oil-Price Confusion

p. 64

Houston Plant Alkylates Mixed Olefin Feed Successfully • p. 108

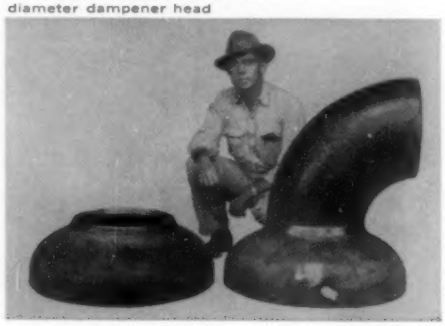
Better, Stronger Piping Assemblies

through new Fluor cold-extruded prefabrication

Alloy steel header, with cold-extruded nozzles

Cold-extruded header, containing 45° miter weld

16-in. outlet nozzle, extruded in 30-in. diameter dampener head



Simple, more accurate fit-up... smoother nozzle contours... elimination of reinforcing pads assure important savings

WHEN YOU specify a multiple outlet header, cold-extruded by the new Fluor technique, you obtain a prefabricated piping assembly that offers higher strength, closer dimensional tolerance, smoother surface and greater uniformity.

Note these advantages Fluor-forming provides:

BETTER CONSTRUCTION: Fewer and simpler welds. More effective X-ray inspection.

LOWER MATERIAL COST: Elimination of reinforcing pads, saddles and collars makes savings in material costs substantial, especially where alloy steels are used.

SIMPLIFIED DESIGN: Nozzles or branches can be located anywhere along or around the header pipe.

SMOOTH NOZZLE CONTOURS: Minimizing pressure drop, reducing turbulence and erosion.

FASTER PRODUCTION: Less welding, less inspection make possible faster production and quicker delivery.

IMPROVED FIT-UP: Because of uniformly closer dimensional tolerances for each outlet nozzle, fit-up to adjoining piping is simple, accurate.

SAFETY: Uniform wall thickness, even distribution of mechanical stresses, avoidance of reinforcing pads and heavy welds assure protection against failure.

Write for Bulletin CE-0.001. EXTRUSION SALES, Fluor Products Company, Paola, Kansas.

A FLUOR-FORMED Product

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A Glance Ahead

• **Talk of another gas line** from western Canada to the Pacific Northwest has been revived. This line would extend into northern California. It would provide an additional supply for San Francisco and other customers of Pacific Gas & Electric. California will eventually receive the benefit of Canadian gas anyway through the Pacific Northwest system. This flow could be reversed into El Paso Natural lines to California. But if the system isn't reversed, Canadian supplies will still make more San Juan gas available to California.

The line directly into northern California would be a much shorter route and might offer a supply independent of present sources. An opposing school of thought favors exclusive use of the Westcoast-Pacific Northwest-El Paso network for handling the flow of Canadian gas into the U. S. which will be rising steadily.

• **ODM has dropped alkylation** from its rapid-amortization list. Its quota is filled. But with or without certificates of necessity, U. S. refiners are adding alkylation capacity at a rapid clip.

There's now more than 300,000 bbl. daily in existing and planned units. But the figure is certain to grow. Alkylate has two strong points—high octane and clean-burning characteristics—which will make it much in demand for tomorrow's cars.

• **Russian production last year** set a record of 1,680,000 bbl. daily, a brief official announcement says. This is more than is generally credited to Russia and just about in line with estimates for all Russian controlled areas.

The figure compares with official figures of 1,400,000 bbl. daily in 1955 and 1,180,000 in 1954. The Russian announcement said the U.S.S.R. surpassed all goals for oil and gas production and for refined-product output.

• **Look for U. S. refiners** to plan a fairly substantial increment to basic crude capacity this year. Despite the recent addition of capacity in new refineries, new crude units and bottleneck removals in existing ones are going in. Just how much remains to be seen when the Journal's refining survey is completed in March.

• **The steel shortage** will plague the oil industry for a long time. Steel mills for a long time have been accepting orders for line-pipe delivery for 1959. Now they're accepting orders for 1960 delivery. Backlogs of big-diameter pipe are almost nonexistent.

• **The jet age in aviation** is drawing closer. Trans Canada Airlines has ordered 20 Vickers Vanguards and has optioned four more, to go with its fleet of Viscounts. By mid-1961 T.C.A. will be completely converted to jet or turbojet craft—the first long-range airline to do so.

T.C.A. hasn't said what it will burn in the new craft, but the Viscounts, also powered by Rolls Royce engines, use a JP-4 type fuel.

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OIL AND GAS PIPELINES • REFINING • PETROCHEMICALS
EXPLORATION • DRILLING • PRODUCTION • FIELD PROCESSING

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TECHNOLOGY–OPERATION

Drilling-Production

Special Section: The Why and How of Fracturing **91**
By J. O. Scott

Although fracturing didn't start until 1949, it's now hitting about 5,000 wells per month. And it's estimated that about 20 per cent of all producing wells in the United States have been fractured. However, about 25 per cent of the fracture treatments have not been successful, and it behooves a careful operator to consider all the angles carefully before he makes the decision to fracture. Here's a guide to the practical information that's needed to make a good decision.

Ohio Oil's Bryden-Ladd Water-Flood Treating Plant **118**
By Jack P. Powell

Water from this treating plant is used to flood 537 acres of Kansas' Bartlesville sand at 2,400 ft. Four wells, completed in the Douglas formation at 1,400 ft. provide water for the flood. Estimated oil saturation at the beginning of water injection was 48 per cent.

Delta Offshore Has Compact Electrical Setup **122**
By Ed McGhee

This contractor uses one group of engines to provide a.c. current control for the d.c. motors and to drive the a.c. and d.c. generators. This arrangement provides for greatest flexibility while keeping total installed engine horsepower to a minimum.

Modern Drilling **127**

Refining-Processing

Eastern States Alkylates Mixed Feed **108**
By Larry Resen

The sulfuric acid alkylation unit at Eastern States Petroleum Co.'s Houston refinery employs a single vessel with six reaction zones as a cascade reactor. Amylene content of the feed stock has varied from 7 to 18 per cent of the olefin feed, while propylene content has been relatively constant at 26-29 per cent.

Questions on Technology **126**

How yields in catalytic cracking are estimated. A correlation chart and selected references.

The Foreman's Page **129**

Part 2 in the series on heat transfer. How conductivities of materials compare.

Refiner's Notebook **131**

Part 1 of a new series on the corrosion of ferrous-metal tubing in refineries.

Pipelining

Data Telelogging in Pipelining **112**
By Arthur P. Jackel

A new approach to the method of supplying all of the remote controls at remotely controlled stations with a minimum of communication-line facilities. The new system provides for obtaining this information within a period of seconds and for immediate telelogging the data to the home office.

Pipeline Patrol: Polyethylene Tape Proves Value **133**
By Marshall E. Parker

Latest results of a projected long-term test of the value of polyethylene-tape pipe wrap as compared to conventional coating materials indicated a superiority of 3:1, when compared on the basis of current required for cathodic protection.

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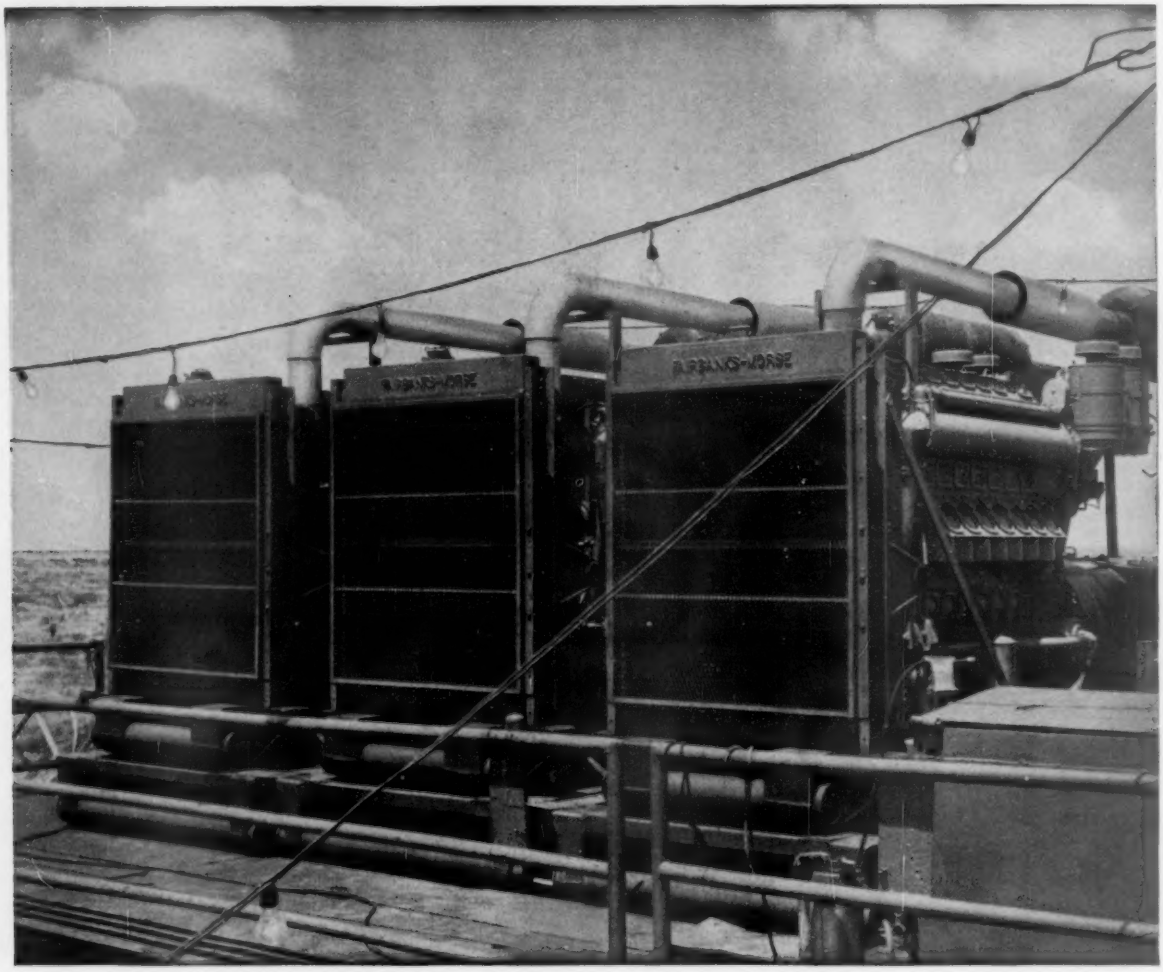


The 38-F-90 is a drilling engine

Here's Why

Fuel?... The 38-F-90 burns gas, propane or liquid fuel with the inherent economies of diesel compression.

Hp. rating?... Continuous slush pump rating is 75 hp. per cylinder, and the six sizes (4-5-6-7-8-10) include the right engine for any job between 300 and 750 hp. Whether four cylinders or ten, it's the same engine, the same width and height, the same operating technique. Many parts are interchangeable.

Speed range?... The 38-F-90 is rated for continuous heavy-duty service from 450 to 1200 RPM. This range is right for any mechanical, hydraulic or electric drive.

Give and take?... The 38-F-90 is a Fairbanks-Morse engine. This means that it will give service and take punishment. Its simplicity and its stamina are the result of its Opposed-Piston two-cycle design and its all-steel welded frame.

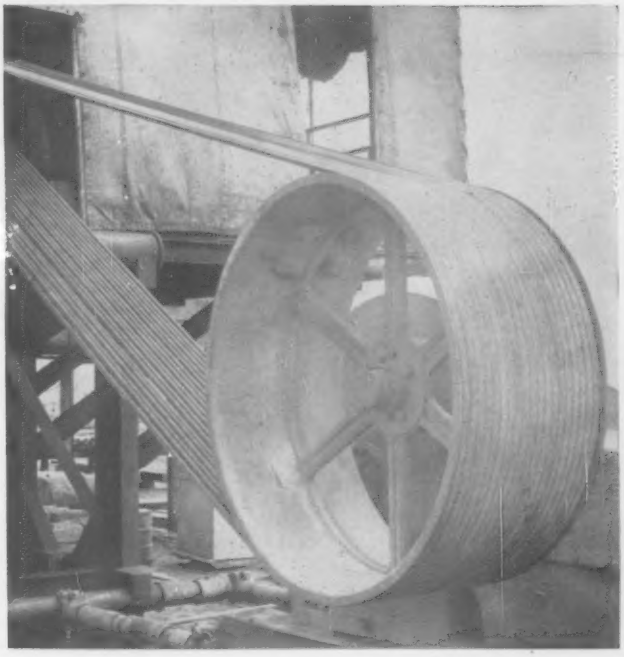
This all adds up to why the Fairbanks-Morse 38-F-90 is a *drilling* engine. Fairbanks, Morse & Co., Oil Field Division, Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

OIL FIELD EQUIPMENT • PUMPS • SCALES • ELECTRIC MOTORS • GENERATORS • LIGHT PLANTS • DIESEL, DUAL FUEL, GAS AND GASOLINE ENGINES MAGNETOS • DIESEL LOCOMOTIVES

B.F.Goodrich



Three costly V belt problems and how they were solved

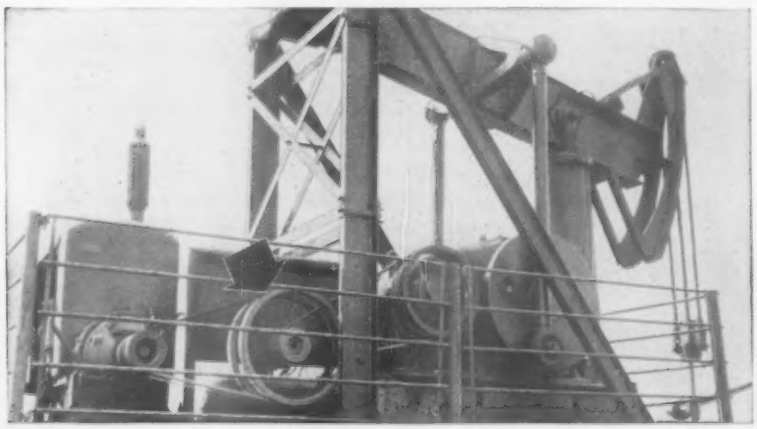
ANY man who works in the oil field knows how expensive it can be when a belt drive breaks down. Here's what happened in the case of three "problem" drives when the operators switched to an entirely different kind of belt—the Grommet V belt, made by B. F. Goodrich.

Upper left—When regular V belts were used to drive the mud pump on this rig, the power loss was high. Now Grommet V belts are used, and the tool pusher says, "They are the most positive and reliable power transmitters we have ever used." Last longer, too! On one of his rigs, a set of Grommet belts lasted 2½ years, drilled 200,000 feet of hole.

Upper right—The problem on this rig was short belt life. The tool pusher solved it by changing to Grommet V belts. At last report, the set shown here had tripled belt service by lasting 28 months.

Lower left—Every time that pump stops, the mechanism has to be pulled out of the 3000-foot well, cleaned, and put back. Some belts lasted only 3 days, others 6 weeks. Then a set of Grommet belts were tried. When the picture was taken, they'd been on 6 months, were still in good shape.

If you're not getting the belt service you should, chances are good that B. F. Goodrich Grommet V belts can solve your problem, too. They're stronger, stand shocks better, don't stretch and slip as much as other belts. And they cost no more. They're sold at leading supply stores and B. F. Goodrich warehouses throughout the oil field. *B. F. Goodrich Industrial Products Co., Dept. M-842, Akron 18, Ohio.*

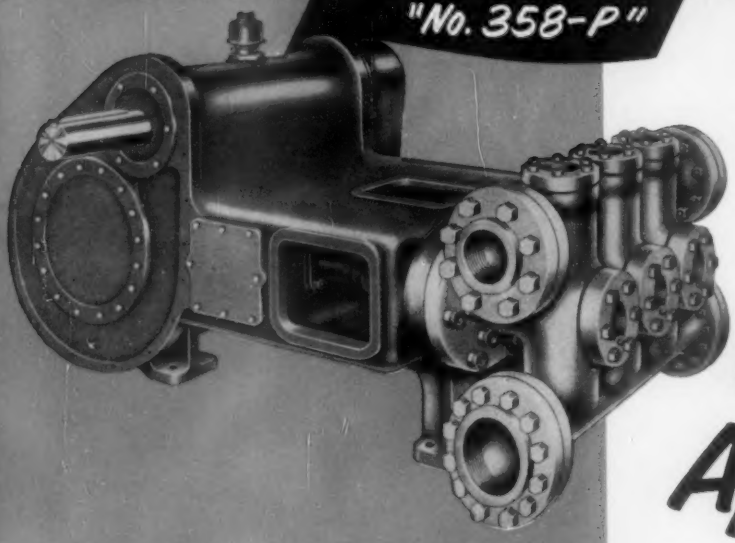


Grommet—T.M. The B. F. Goodrich Co.

B.F.Goodrich

INDUSTRIAL PRODUCTS

This New 8" Stroke "No. 358-P" Plunger Pump



extends the "Oilwell" Line for Waterflood Applications

WHEN YOUR WATERFLOOD PLANS call for larger-volume high-pressure injection, it will pay you to investigate the economies of installing fewer "Oilwell" No. 358-P Triplex Plunger Pumps instead of a greater number of smaller units.

This new 8-inch stroke size, like the time-proven 4-inch and 6-inch stroke units, is designed with reduction gear, to provide the pressure-volume desired at slower operating speeds and with a wider selection of prime movers.

With this design, slower plunger speeds with fewer reversals result in less wear on packing, plungers, crossheads and all moving parts including valve service. And, horizontal heavy-duty construction means minimum suction-head requirements, less piping vibration and greater accessibility.

DISPLACEMENT AND HORSEPOWER REQUIREMENTS

Plunger Size Inches	Maximum Working Pressure psi	NO. 358-P DISPLACEMENT Barrels per 24 hours at Pump Speeds (rpm) of: 75	100	125	150
3¼"	2,410	2,210	2,950	3,680	4,430
3½"	2,080	2,570	3,430	4,290	5,145
4"	1,590	3,330	4,460	5,550	6,680
4½"	1,260	4,250	5,655	7,060	8,460
5"	1,020	4,870	7,000	8,740	10,500
Pinion Shaft RPM Gear Ratio 4.05:1		304	405	506	607
BHP Required		107	142	178	214

Note these Maintenance Advantages:

(1) Suction and discharge valves are interchangeable and either can be quickly removed for servicing without disturbing the other.

(2) Each stuffing box is removable through the frame cradle for replacement should this become necessary.

(3) Two-piece plunger-and-shank assemblies permit changing of plunger sizes without disturbing the power end and allows use of uncut packing rings.

(4) Crossheads are equipped with adjustable and renewable shoes. Hardened steel, tapered fitted pins are finish ground to size and may be set in either of two positions, 90° apart, to distribute wear.

(5) Wide-faced single-helical gear train is mounted in heavy-duty, adjustable, tapered-roller bearings which have oilbath lubrication.

FOR PUMPING APPLICATIONS . . . that demand dependable performance, let us quote on the pump from our complete line to meet your requirements... **MOST ECONOMICALLY.**

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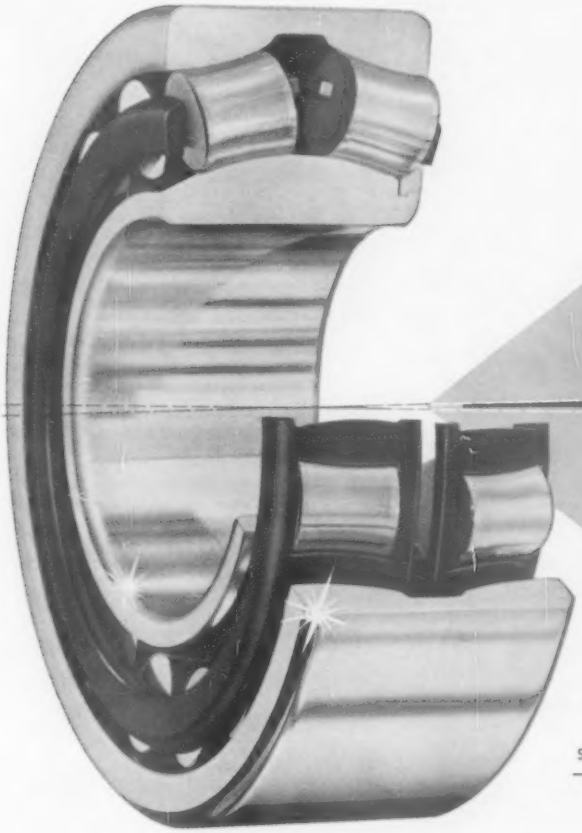
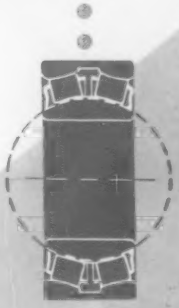
USS TRADE MARK

"OILWELL" TRADE MARK

UNITED STATES STEEL

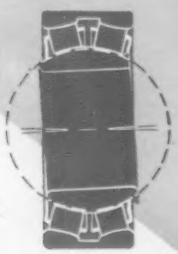
Self-aligning TO KEEP ITS CAPACITY IN ROUGH, RUGGED SERVICE





THIS IS SELF-ALIGNMENT. Spherical inner ring is free to align itself in any direction. Thus . . .

FULL LOAD CAPACITY is always assured, regardless of shaft deflection or misalignment.



Series 22200 and 22300 —22500-A and 22600-A roller bearings

Spherical LINK-BELT roller bearing compensates for shaft deflection, weaving of supports

MANY leading makers of tough duty equipment now design without bulky supports to prevent deflections. They're using this spherical Link-Belt roller bearing that *compensates for misalignment* . . . always keeps its full capacity for handling radial and thrust shock loads without "pinching."

In addition, it's factory-adjusted, easy to mount and available everywhere with internationally standardized boundary dimensions.

Link-Belt also makes industry's most complete line of ball and roller bearing blocks. They're all in Book 2550—yours for the asking at any Link-Belt office or Authorized Stock-Carrying Distributor. 14,443-B

LINK LB BELT

self-aligning ball and roller bearings

LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 21, Odessa, Tex., Shreveport, La., Los Angeles 33, Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields.

1956 has, in many respects, been a record year for us . . . characterized by advances in technology and an all-time high in volume of new orders and also billings throughout the world. This meant a year of strenuous adjustment due to the necessity of increasing our productive capacity to parallel our growing volume of business.

The acquisition of the Merco Centrifugal Co. of San Francisco on February 1, added centrifugals to our product line. This natural outgrowth of our cyclone work has proven to be a most successful move. Similarly, the year has demonstrated the strength of our new Canadian subsidiary, Dorr-Oliver-Long of Orillia, which became the newest member of our corporate family on January 1, 1956. Yet another step in the overall corporate growth picture was the completion of plans to add the ninth member of our overseas family, Dorr-Oliver Pty. Ltd. of Australia on January 1 of 1957.

Steps in matching our productive capacity to our growing needs included a million dollar expansion of our Hazleton plant scheduled for completion at the year's end and the opening of a sizable new production facility nearby in Pennsylvania. Currently, a long term expansion and reallocation program is underway which will step-up our ability to produce, and to serve, still further.

Growth and change in other operating areas of the parent company also kept pace. A broad reorganization of our domestic sales structure added new geographical divisions and was principally designed for better sales coverage and service. In engineering, the pressure of increased volume resulted in the opening of a branch engineering office in Pennsylvania, close by our East Coast plants, which has proven to be most worthwhile.

SANITATION — The new Spirovortex-Superate Filter will produce a degree of purity comparable to that attained using the activated sludge process in plants treating up to one MGD of domestic sewage. We have developed the Degritting Clarifier and Clarigester for low cost grit removal in small plants and during the year we have incorporated important new features into the design of our Vacuum Filters for the sanitary field.

The completely D-O equipped sewage treatment plant for Karachi, Pakistan, represents the largest order in the sanitary field ever entered by our associates in The Netherlands. Typical of other new D-O equipped installations are those under construction in such diverse locations as Charlottesville, Virginia; Caldwell, Idaho; Midwest City, Oklahoma; Delhi, India; Nairobi, Kenya; and Rio de Janeiro, Brazil. Expansion of Providence, Rhode Island, treatment facilities calls for installation of nine Dorr Clarifiers, all over 100 feet square, and at Louisville, Kentucky, four 275 foot long Monorake units will be added.

RESEARCH AND DEVELOPMENT — As a matter of policy, fundamental research continues on our expanding line of basic unit operations. The principle of operating in many different but allied fields stimulates situations wherein fundamental research can produce new and useful products and processes. Such is not possible when interest is confined to but a few basic operations, as in our early years.

Similarly, general company development is continuing the search for new products allied in some manner with our experience and facilities. In this search we count heavily on the assistance and cooperation of our Associates throughout the world.

POLYETHYLENE — Our contribution to one of today's most spectacular and rapidly growing fields — polyethylene — is the Merco Pressure Centrifuge, developed specifically for high pressure, high temperature operation. The basic unit was developed, designed and manufactured in record time to keep pace with the expanding industry. First commercial Centrifuges will go on stream early in 1957 separating catalyst from liquid polyethylene.

FERTILIZER — One of the highlights of the past year was the largest single D-O order ever received involving a phosphoric acid and 200,000 ton per year triple superphosphate plant for a Florida producer. The scope of our services on this project includes architect-engineer design, supply of equipment and construction materials, and supervision of erection and initial operation of the plant.

Other major design projects undertaken during the year were a 350,000 ton per year complete granular fertilizer plant in Great Britain, a 350 ton per day ammonium phosphate installation in Montana, and a phosphoric acid plant for Venezuela designed to produce 50 tons of P_2O_5 per day. During the year construction of a D-O engineered Scottish granular fertilizer plant was virtually completed, and Traveling Pan Filters were ordered for the difficult gypsum-phosphoric acid separation in a number of new chemical fertilizer plants around the world.

PETROLEUM — The Hi-Rate Pressure Filter has proven successful as a high-capacity water filter in oil field secondary recovery operations with rates higher than those of conventional units. Initial test work in other fields indicates the versatility and possibility of unusually widespread application of this new filter.

A variation of the D-Sander, first introduced in 1955, has been developed for removal of fine silica from rotary drilling fluids. The petroleum industry purchased during the year over one hundred D-Sanders of both basic types.

METALLURGICAL — Recently placed on the market, the DSM Screen is an ingenious, high capacity screen capable of separations as fine as 200 mesh. Adapted from the Dutch design, the unit has operated very successfully on coal and will handle a wide variety of non-fibrous feed slurries. Other highlights of the year include a number of Thickener-Filter combinations and Bowl Desiltors installed in Eastern coal fields, a D-O equipped iron ore washing plant in California, and a variety of cement plant expansion equipment orders.

FLUOSOLIDS SYSTEMS — A large steel producer in the United States finalized plans for a new fine coal washing plant using a two Reactor FluoSolids Coal Drying System designed to handle 600 tons of metallurgical coal per hour. In the non-metallics field, three fluidized Reactors went into operation — two in the Detroit area drying blast furnace slag used in cement manufacture, and the other calcining clay in Scotland. Systems are now under construction to dry and pre-heat oyster shells and to calcine Massachusetts limestone.

Four new installations in Japan will roast 265 tons of zinc concentrates daily, producing both a readily usable calcine and SO_2 bearing gases for contact sulfuric acid manufacture. During the year two installations in the U. S. and South Africa operated successfully roasting copper for direct electrowinning. And pyrite roasters were ordered for a Canadian uranium mill, Chilean and Nicaraguan copper concentrators, French and Philippine fertilizer plants, and two Scandinavian pulp mills. In all, 21 fluidized Reactors were sold in 1956.

INDUSTRIAL WASTES — D-O equipped treatment plants handling chemical wastes were installed by a German and two British chemical manufacturers. The former installation incorporates the first D-O equipment to be purchased for this purpose in Germany since World War II. Next year two Southern pulp mills will clarify wastes in giant 300 foot Thickeners installed in earthen basins, and a U. S. steel company will recover flue dust in a completely D-O designed installation. Two similar flue dust recovery stations were also ordered from our British subsidiary during the year.

The year's impressive record of sales and technical accomplishment has been made by the hard work of our staff in every corner of the globe. The success of our operations naturally rests wholly with them, despite the importance of the tangible facilities and tools with which we work. In the year now drawing to a close this was again demonstrated, and as the tools and facilities we give them expand and become of better quality, so will our staff be able to produce greater volume and increasing returns.

J. D. Hitch, Jr.
November 20, 1956 *President*

"Speed and versatility cut pipe-pushing costs"

says Allied Gas Company

If light pipelaying work is on your schedule, get the facts now about the Oliver OC-3!

Here's the little tractor properly sized for the job—available with hydraulic side boom, rear towing winch, front-mounted backfill blade and pipe bending shoe. With "Little Boomer" you're set to handle all kinds of jobs along the pipelines—at less cost—and without tying up larger, more expensive equipment.

The Allied Gas Company of Paxton, Illinois, is a case in point. Since purchasing their "Little Boomer" in September, 1955, they've kept it busy grading and backfilling, winching, bending 3″ and 4″ pipe and lowering in. They can't say enough for its easy handling and versatility.

With a total weight of only 5205 pounds, the OC-3 provides a lifting capacity of 2000 pounds at a boom angle of 70°—handles laying and lowering operations on pipelines up to 6″—carries 40′ lengths of 12″ pipe—unloads and transports pipe—and is ready to move other equipment, too. Operation is simple, performance dependable. Compact size and differential steering give it unexcelled maneuvering in close quarters.

This new bulletin has the information you want—with application photos, specifications, etc. Ask your Oliver distributor for your copy or write us for Bulletin A-1042.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

OLIVER

A COMPLETE LINE OF INDUSTRIAL WHEEL AND CRAWLER TRACTORS AND MATCHED ALLIED EQUIPMENT

6,000 horsepower in a single CLARK CBA-8 balanced/opposed compressor

Now, for the really big applications, Clark introduces the most powerful compressor ever built—the new CBA-8. The ability to handle tremendous horsepower, however, is not the only feature of this new compressor. Being extra heavy and rugged in all respects, it is the perfect choice for those services where extremely high pressures are required such as in the process industries and for high pressure wind tunnel applications.

High discharge pressure invariably causes a high pressure rise across the cylinders which results in heavy pin loads. The new CBA-8 is designed to carry pin loads of 100,000 pounds with ease. For large air compressor installations, at normal pressures, the CBA-8 will operate with minimum maintenance because of its heavy construction. The balanced/opposed design principle, originated by Clark, assures vibrationless operation.

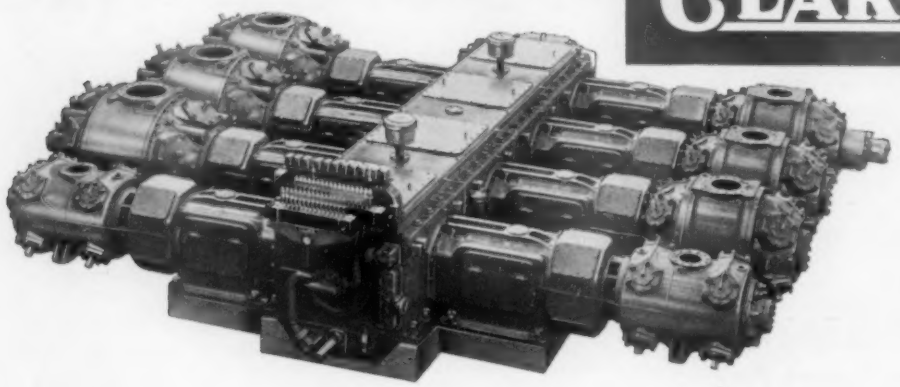
Two new CBA-8 units already have been delivered for a special application. Your Clark representative will gladly give you full details on this new unit.

CLARK BROS. CO. · OLEAN, N. Y.
One of the Dresser Industries
Sales offices in Principal Cities Throughout the World

Balanced/Opposed Compressors

CLARK®

ONE OF THE DRESSER INDUSTRIES

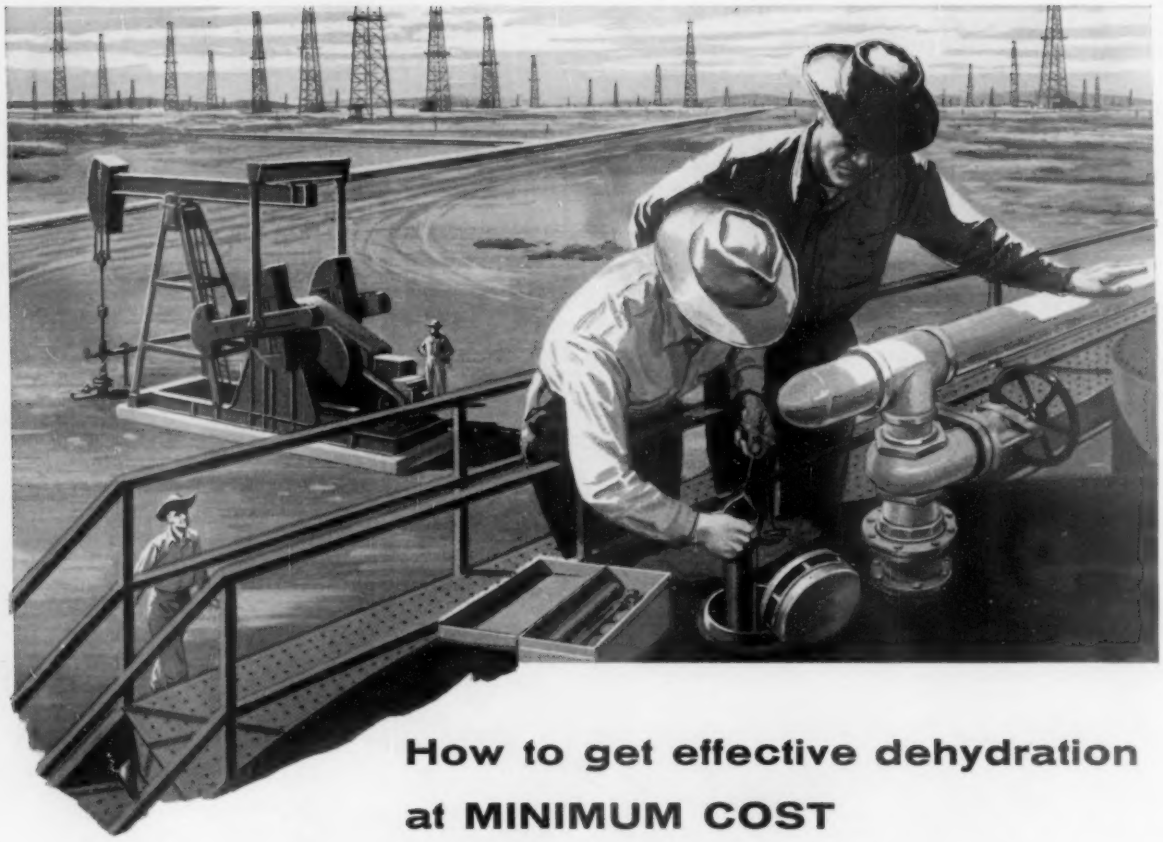


COMMERCIAL air transportation is one of the fastest-growing industries in America. But it should never be forgotten that with almost every new stride this industry has taken, the petroleum industry has had to be one jump ahead . . . has had to be ready with the lubricants and fuels to fit the job. We of The Texas Company are proud that our association with this vital industry has been such a long and successful one. In fact . . .

For more than 20 years, more scheduled revenue airline miles in the U. S. have been flown with Texaco Aircraft Engine Oil than with all other brands combined.

The Texas Company

TEXACO



How to get effective dehydration at MINIMUM COST

Chemical treatment of crude to bring it to pipeline standards can be an economical, profitable operation—if it's done right.

Aquaness field men work on the principle that there's only one right way to find the best answer to your well's dehydration problem. And that's by working at your well—for days, if necessary—until they get the one combination of chemicals that exactly fits your well fluids and your treating system.

This takes patience, and a lot of experience. Aquaness men know the oil industry, from years of field work in a wide range of treatment problems. And they have a complete line of uniform, high quality chemicals which they can use in almost endless combinations, to produce a broad variety of treatment effects to match your well's needs.

Write today for the new Aquaness booklet, "Production Treatment of Crude Oil."

Aquaness *Department*
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ATLAS POWDER COMPANY
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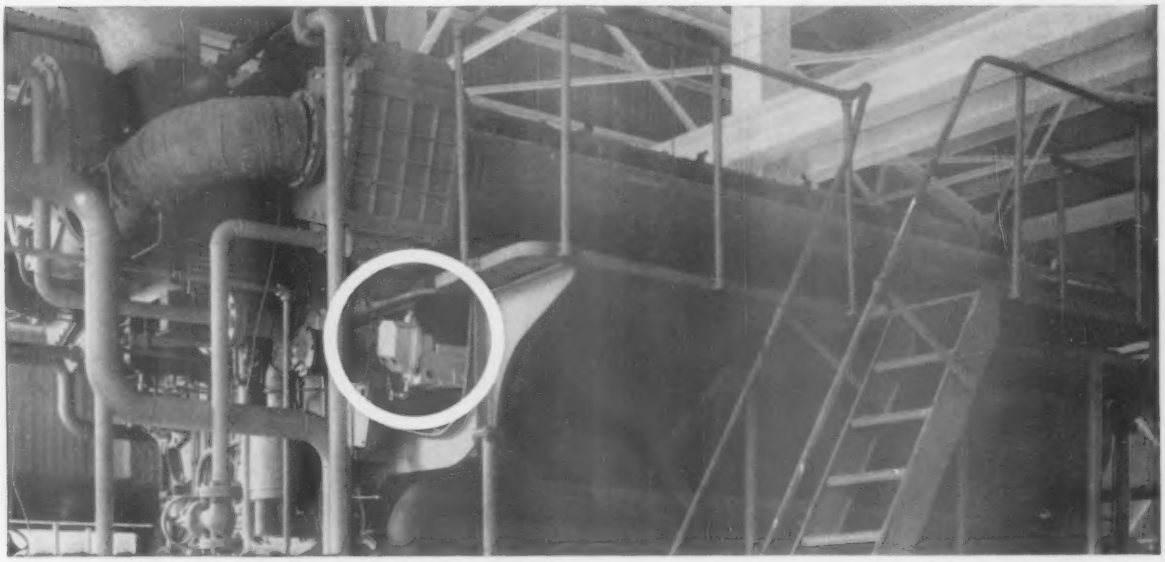
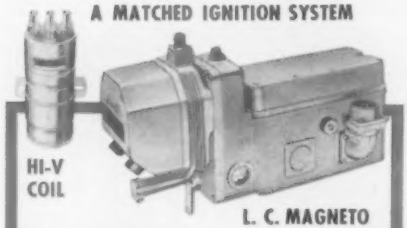
BLUE SUNOCO → SUN OIL COMPANY



uses Cooper-Bessemer Engines with BENDIX MAGNETOS at their Marcus Hook Refinery!



1. Long service life
2. Simplified maintenance
3. Longer spark plug life
4. No unscheduled ignition shutdowns
5. Positive spark timing
6. High voltage output
7. Matched ignition system
8. Single or dual ignition
9. Flame proof
10. Low maintenance costs
11. For engines of 6 through 16 cylinders

Pictured above is a section of the power equipment used by the Sun Oil Company in an ammonia plant at their huge Marcus Hook Refinery.

Typical of Sun's utilization of the most modern equipment in their refining process is this Cooper-Bessemer Model LSV12 engine equipped with Bendix* L. C. Magneto and Hi-V Coil.

Because the Bendix L. C. is a completely new type of magneto, it incorporates the latest developments in engineering, design and production techniques. The result is a matched ignition system—L. C. Magneto plus Bendix Hi-V transformer coils—that delivers more than ample voltage with greatly reduced maintenance costs.

That's why whenever top performance is a must, you'll find more and more important operators making the new Bendix L. C. Magneto their choice.

*TRADE MARK

SCINTILLA DIVISION OF BENDIX AVIATION CORPORATION, SIDNEY, NEW YORK

Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

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J&L Service

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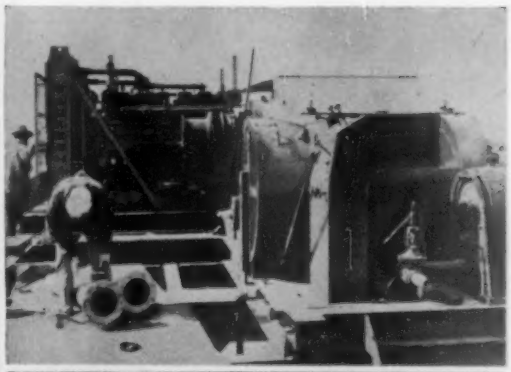
Rotary Rigs

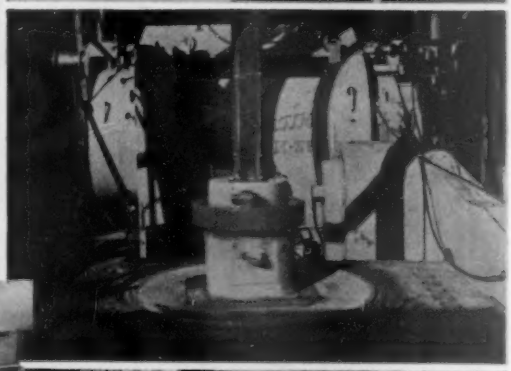
A driller's natural desire to own the last word in equipment has made Ideco the most wanted rotary rigs in the world.

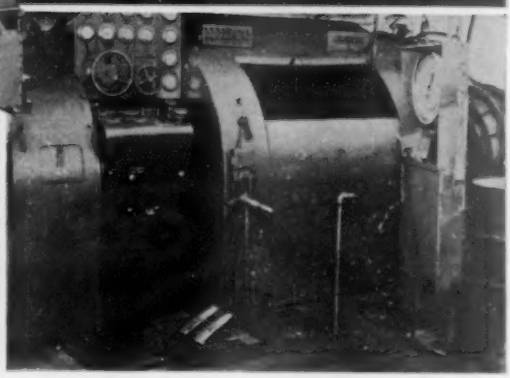
J&L parts service wraps up this situation—makes these finest of all rigs the best buy in the United States and Canada.

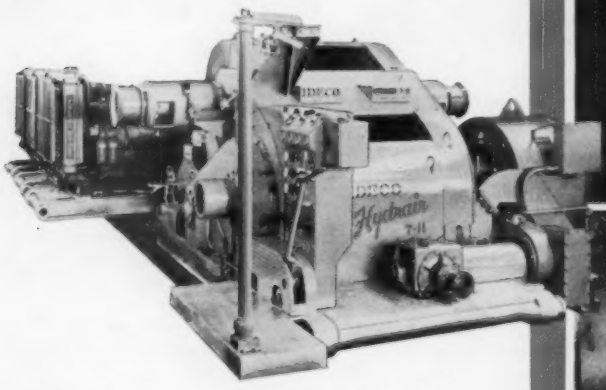
J&L has an Ideco designed and rated to do the job you have in mind and—thanks to J&L service—keep on doing it.

For detailed descriptions, specifications, performance characteristics, get your J&L store on the telephone. Ask for Catalog No. 55.









Rig capacities from 2,500′ to 20,000′ with 4½″ drill pipe. Rigs to 6,000′ capacity can be trailer mounted.

"Hydrair" hoists combine a hydraulic torque converter drive with air clutch and air controls.

Power rigs have a mechanical or fluid-coupling drive, with air clutch and air controls.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

SERVING THE UNITED STATES AND CANADA

10-MA

Unique combination of fine engineering and economy!

...the new FOXBORO M/44 INDICATING PRESSURE TRANSMITTER

- **Easier to Read . . . large indicator scale, visible at 20 ft.**
- **Easier to Calibrate . . . simple adjustments "on location"**
- **More Compact . . . single, integral instrument**

Any way you look at it, the new Foxboro M/44 Pneumatic Pressure Transmitter gives you an unmatched combination of fine engineering and economy. First; because it *is* an engineered instrument. There are no attachments or "makeshifts". Second; because it utilizes standard Foxboro parts throughout—parts which have been performance-proved in thousands of successful installations of other Foxboro Instruments. And this means not only top performance, but easier servicing and stocking as well. Third; calibration is simple, right in the field, because the M/44 is "convenience-designed" by men with years of experience in every phase of instrument design and application.

In appearance, too, the M/44 has unmistakable Foxboro quality. Features like the high-legibility indicator scale, the compact drawn-steel case with tough polyester plastic cover. It's the neat, high-efficiency, low-cost pressure transmitter for centralized operation or control. All standard ranges.

Write for complete details

THE FOXBORO COMPANY
601 Neponset Ave., Foxboro, Mass.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

FOXBORO
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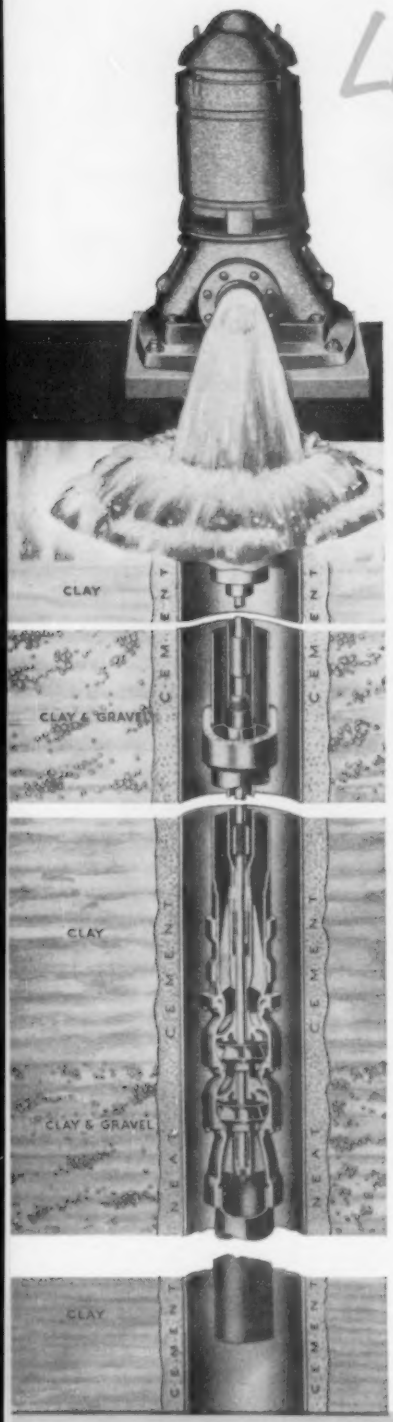
INSTRUMENTATION FOR INDUSTRY

Layne knows more about water bearing formations!



On whose say-so? Not on ours—but on the experience of scores of American and foreign firms and municipalities whose very existence and success depend on an adequate supply of water.

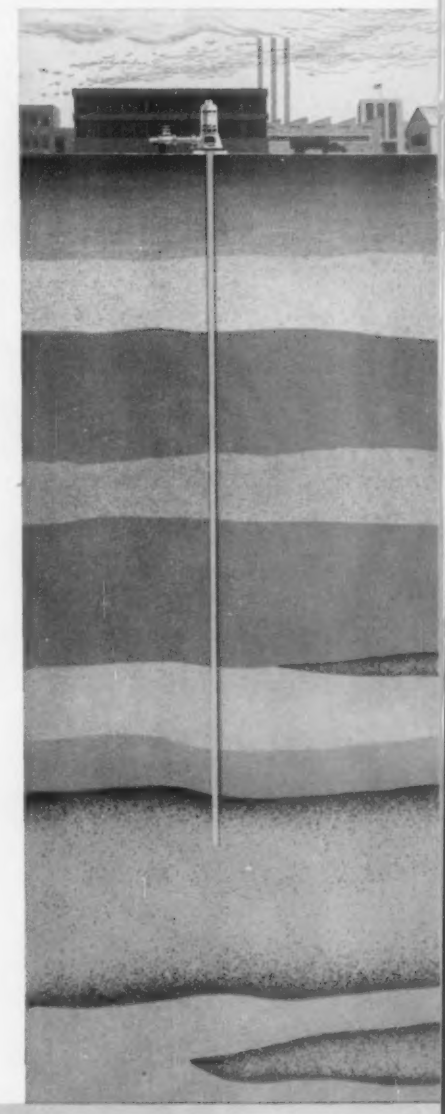
Knowing where the water is — and then tapping the subterranean source is but a part of the vast knowledge the Layne organizations have accumulated in three quarters of a century.

Once the source is determined and the water supply developed, a dependable means for delivering the water must be provided, and that's where the famous Layne pump comes in. For each Layne pump is specifically engineered for the particular job. There is no "stock" Layne pump. Your pump is created for your job —making use of the knowledge of strata, water requirements and usage.

ENGINEERED, DEPENDABLE PERFORMANCE IS WHAT YOU GET WHEN LAYNE DOES THE JOB — COMPLETE FROM WATER LOCATION TO YEAR AFTER YEAR OF TROUBLE-FREE PUMPING.

YOUR NEXT WELL AND PUMP INSTALLATION MAY BE MONTHS OFF. GET TO KNOW THE LAYNE FOLKS IN YOUR AREA. SAVE TIME AND MONEY THROUGH THEIR INTIMATE KNOWLEDGE OF WATER.

Send now for our general services bulletin No. 100.



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Years of effective mud conditioning prove high performance of PALCOTAN®

Over four years of continuous large scale commercial use in important drilling areas throughout the world now back up the findings of over a decade of field and laboratory research. *Palcotan*, the unusual chemical extract of California redwood bark, has "come of age" as a low cost, stabile, easy to handle compound to control viscosity, gel strength and water loss in drilling muds. Now, for the first time, following the third in a series of plant expansions, *Palcotan* is available in sufficient quantity to meet all requirements. So if previous shortage has prevented your use of *Palcotan* in the past, plan now to put it to work. Exceeding specifications for quebracho in many applications, *Palcotan* is particularly efficient in low concentrations, is readily soluble in cold water, may be added with or without caustic, and comes in a non-toxic coarse powder form packed in convenient multiwall 50 lb. bags. Write today for full information.

Available through oil field and mud service organizations

Write for Bulletin No. 4-01 describing the properties and operating advantages of Palcotan

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THE PACIFIC LUMBER COMPANY

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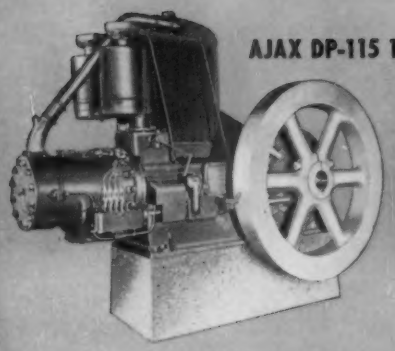
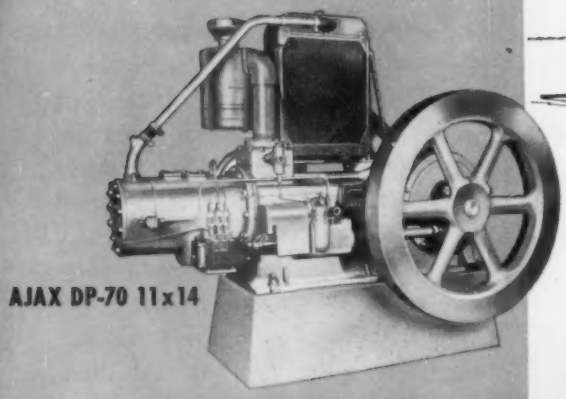
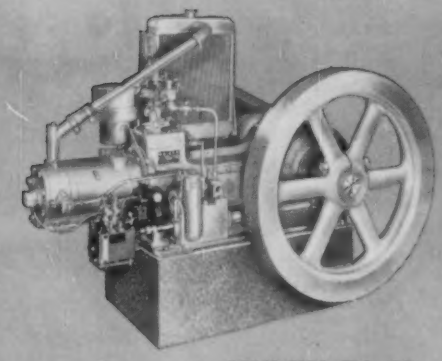


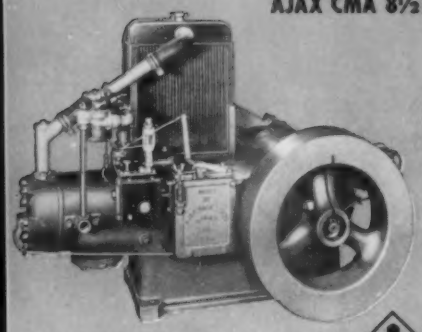
AJAX DP-115 13¼x16



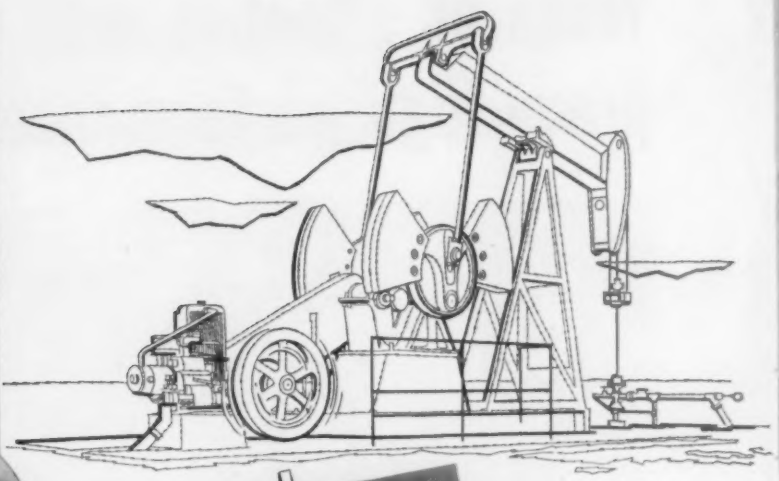
AJAX DP-70 11x14



AJAX CMA 8½x10



AJAX WL 5x6½



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Cheap Power

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by *Ajax*

CHEAP POWER makes money for you . . . costly power drains it away. You can figure your savings with AJAX AND GAS in terms of gas vs. purchased power costs in *your* locality—delivered to *your* wells—consumed on *your* jobs. (Or send us the data and we'll do the work!) ● When you see the solid money difference, see your Supply Man, fast!

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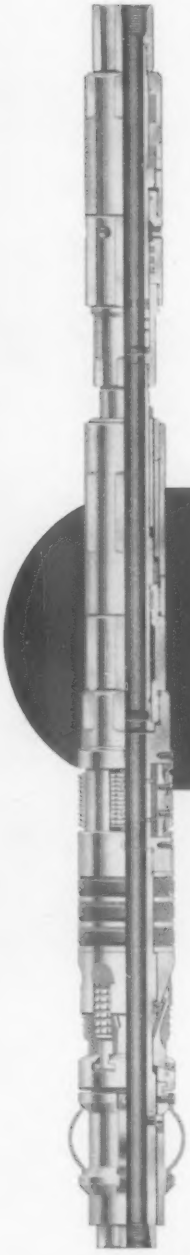
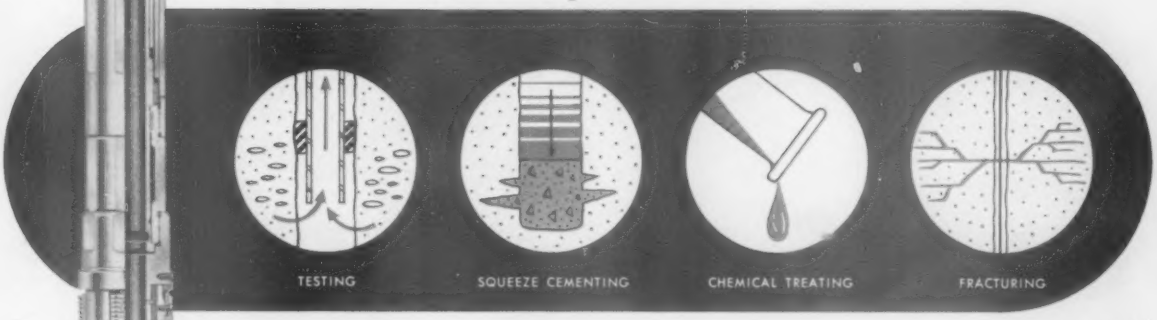
TEST-TREAT-SQUEEZE
on one trip with one tool



THE NEW HALLIBURTON

RTTS
PACKER
(RETRIEVABLE TEST—TREAT—SQUEEZE)

Rig-time quickly runs into money... but Halliburton's Retrievable Test—Treat—Squeeze Packer gets jobs done in "jig-time". This new time and money saver does four important jobs at any point in the well... all on one trip in:



PLUS:

- *providing full open passage for tubing-type perforating gun.*
- *a full-opening tubing-testing device.*
- *safety joint protection.*
- *retrievability.*

The new Halliburton RTTS Packer sets new standards for dependable performance and rig-time savings that add still further to the efficiency and economy of Halliburton cementing, chemical and fracturing services. This versatile tool is one more example of how Halliburton research and development help to put more oil in your tanks... and more profit on your books.

Ask for "RTTS" Bulletin

Call the local or district office or write the Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON CEMENTING SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG

Overall view of the UOP Platforming-Unifining units at the Cheyenne (Wyo.) refinery of Frontier Refining Company.

Unifining unit reactor, with reactor charge heater in background.

Frontier engineer adjusts fuel gas control valve on Platformer charge heater.

Unifining Cat Cycle Oil Solves Major Sales Problem For Frontier

By M. H. Robineau
President
Frontier Refining Company
Denver, Colo.

A year of steady progress has been experienced by our company since the installation of two new refinery processing units—a UOP Platformer and a Unifining unit.

M. H. Robineau

Before these processes were added, Frontier had a serious sales problem due to the high sulfur content of our cat cycle oil which made it difficult to market profitably our entire daily production of 1,600 barrels of this distillate. We had two markets for this material—Diesel fuel for the Union Pacific Railroad and No. 2 domestic burner oil.

Since the cat cycle oil as such had a sulfur content of 1.25 weight per cent, it failed in its original state to meet the railroad's specifications. Hence we were forced to blend it in equal proportions with a straight run Diesel fuel—for which we had a ready truck market—in order to produce a fuel which met the UP's standards. This operation was economically undesirable because the straight run Diesel which could have been sold for 11 cents a gallon as truck fuel, had to be blended with cycle oil to make a product acceptable to the railroad and for which we received approximately 9 cents a gallon. Compounding the problem was the fact that after selling the maximum possible quantities to the railroad, truck lines and home heating markets, we had remaining several thousand barrels a month of cycle oil which were sold at sacrifice prices as industrial oils because of the high sulfur content.

Another facet of the problem was a short supply of straight run Diesel oil, and there appeared to be little chance that additional amounts could be obtained from the two crude topping units, whose combined daily capacity approximated 10,000 barrels.

Frontier sought the help of Universal Oil Products Company to improve its distillate stock position. UOP, after extensive engineering and pilot plant studies, recommended that we install a Unifining unit to operate alternately on a charge of either 3,000 B/SD of straight run distillate or 2,500 B/SD of a 50-50 blend of cat cycle oil with straight run distillate.

Frontier "bought the idea." However, a major obstacle had to be overcome—a practical source of hydrogen. It was decided to add Platforming not only because it would provide an economical source of hydrogen but because it would also substantially improve the overall octane rating of the refinery's gasoline and would effect considerable savings in the quantities of tetraethyl lead used for motor fuel blending purposes.

The contract for constructing the units was awarded to Procon Incorporated, and work was completed on schedule. With the aid of electronic instrumentation (Frontier is the first U. S. refinery to have liquid level indications completely transmitted by electrical impulses to the graphic panel), the units were lined out in relatively short time. Operation of the Unifining unit differed from the original schemes from the beginning. Instead of running on one of the alternate operating plans, cat cycle oil was charged to the unit and it ran on this feed for approximately two months.

Unifining this oil brought notable results. More than 90 per cent of the sulfur was removed, the bromine number was sharply reduced, compatibility was improved, and the cetane number and Diesel index were increased so that more cat cycle oil could be blended off into a higher priced product. The net result was the elimination of a product which formerly was sold at sacrifice prices in favor of one which required no special blending to make it 100 per cent salable.

With the Platformer, Frontier has increased by three numbers the octane ratings of its gasolines while substantially reducing its requirements for tetraethyl lead. The ease of octane improvement inherent to Platforming has made it possible to use natural gasoline, previously employed to upgrade octanes, more profitably elsewhere in the refinery.

The successful operation of the Platforming and Unifining units has given Frontier a new impetus which has been reflected in a more economical refinery operation and a greatly expanded marketing program, the latter by virtue of our ability to offer to the public a variety of products much higher in quality than had been possible previously.

Frontier combines UOP Platforming and Unifining processes for increased operational economy and expanded marketing program

designed, engineered and licensed by

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD
DES PLAINES, ILL., U.S.A.

Forty Years Of Leadership In Petroleum Refining Technology

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the Mid-Continent Supply Company
STORE MANAGER
MID-CONTINENT SUPPLY CO.
His job is SERVICE.. around the Clock!
Your Mid-Continent Store Manager is a good man to know. He maintains one of the largest inventories of supplies and equipment in the oil fields. He keeps a crew of field men and warehouse men at your service 24 hours a day. He is a seasoned veteran of the oil fields with a working knowledge of drilling and producing supply problems.
Drop in and get acquainted at the store with the blue neon derrick.
PESA
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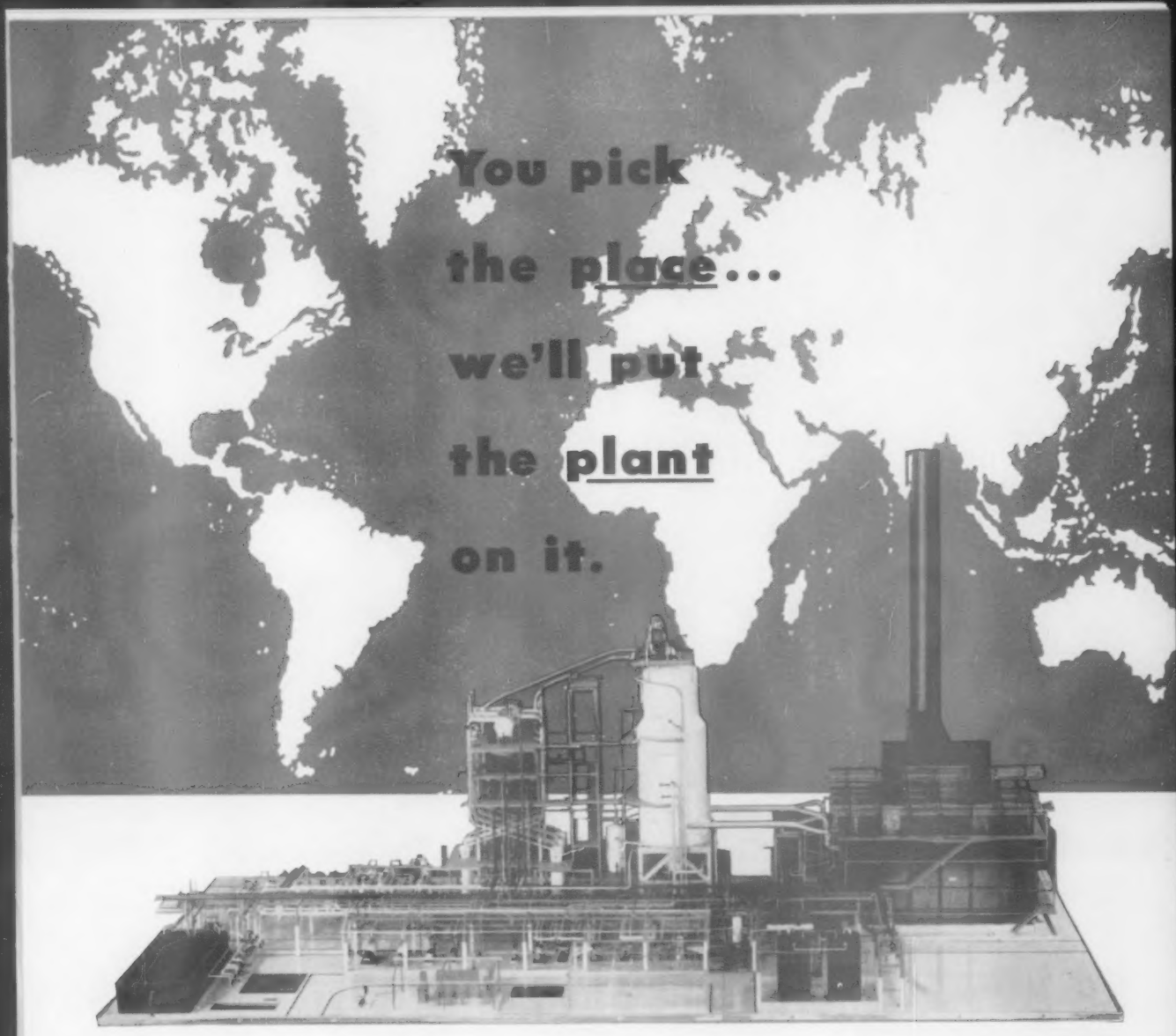
MID-CONTINENT BLDG. FORT WORTH, TEXAS
THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY



IN fact, McKee's fifty years of experience in designing and building plants for major industries can be a valuable help to you in selecting the site.

And McKee can undertake the entire project from preliminary studies to completed plant, ready for initial operation, under a *single contract.*

You'll find physical evidence of the excellence of McKee engineering and construction in successfully operating plants all over the world. If you want your new plant designed and built to earn a profit *call in McKee.*

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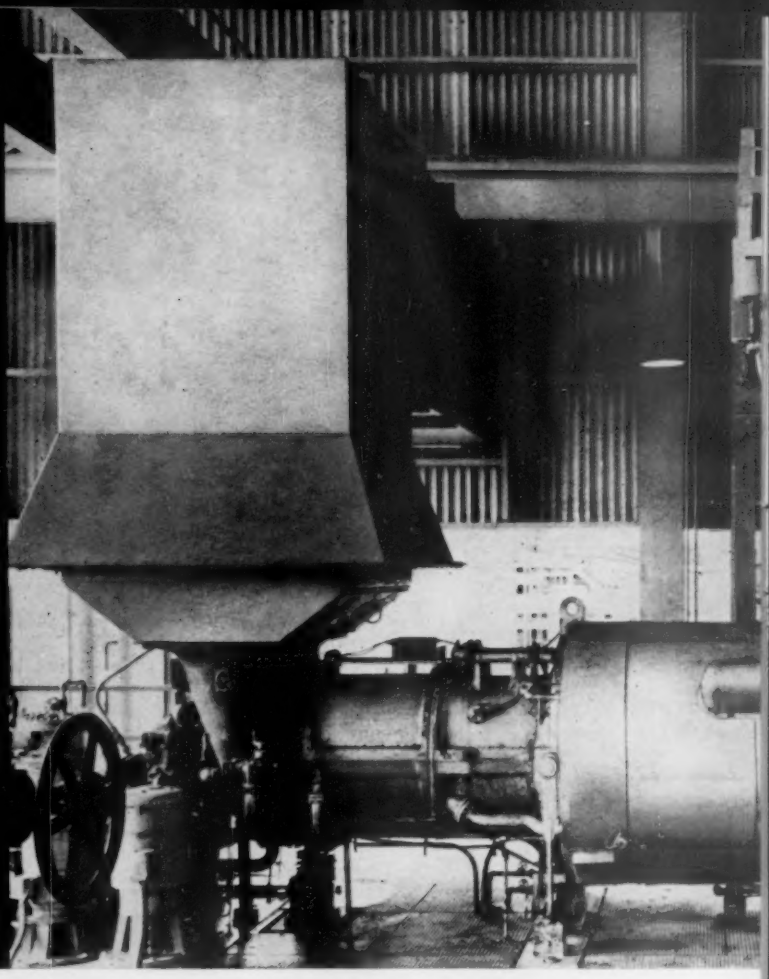
1. RESEARCH AND DEVELOPMENT

2. MANUFACTURING SKILL

3. ENGINEERING SERVICES

4. UNIT RESPONSIBILITY



IN REFINING process, General Electric gas turbine can supply shaft power, exhaust heat, compressed air. Above, turbine drives 3 compressors in tandem.

4 ways General Electric prime-drive systems

When you specify General Electric equipment, these product "added values" help you protect your equipment investment

TWO MAJOR FACTORS affecting your refining costs are unexpected equipment outages and maintenance. Here are four added values, offered by the General Electric Co., to help you protect your vital electrical system against breakdown and excessive maintenance.

1. **RESEARCH AND DEVELOPMENT:** To assure advanced design and construction, General Electric spent over three times as much, per sales dollar, on 1955 research and development than the average of all manufacturing companies.

2. **MANUFACTURING SKILL:** 77 years' experience and a backlog of skilled labor help provide you with more dependable, higher quality, standard or custom-built electrical equipment.

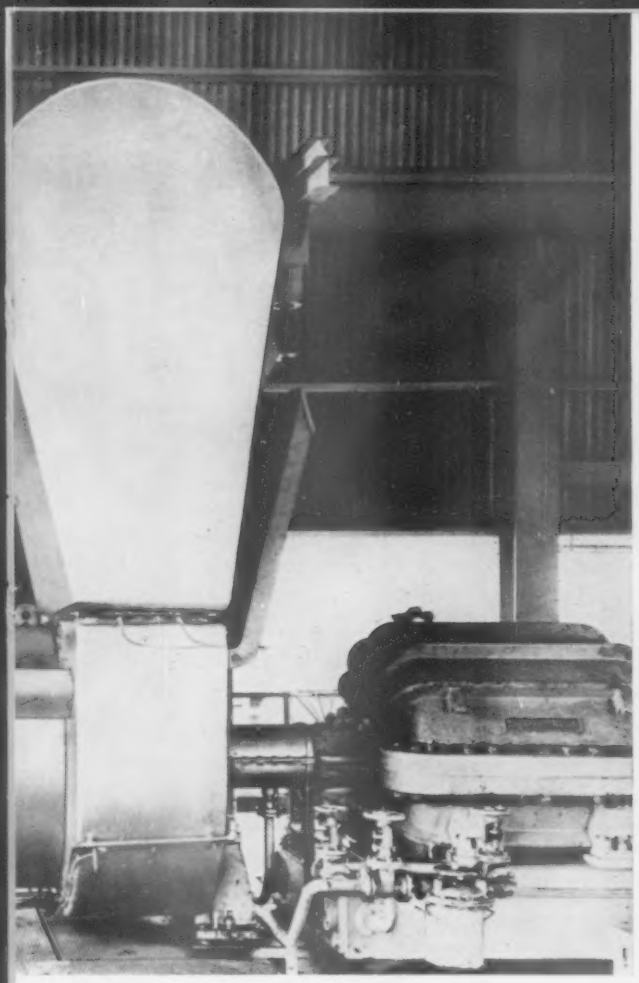
3. **ENGINEERING SERVICES:** 6 engineering services (project co-ordination, application engineering, product development, analytical engineering, installation and service engineering, maintenance service) are available to you and your consultants from planning stages through start-up.

4. **UNIT RESPONSIBILITY:** General Electric provides one-source supply of all the components in your mill's electrical system, plus engineering help in the design, installation and start-up.

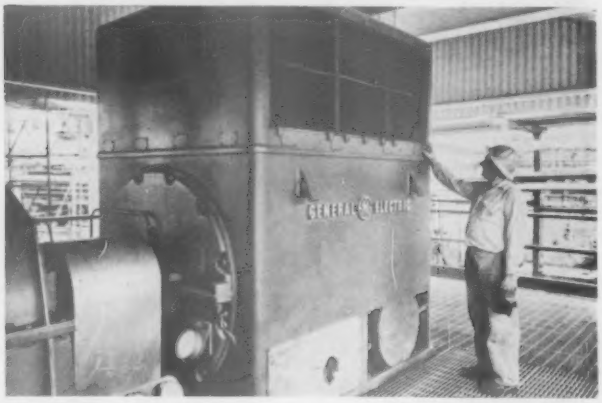
CONTACT your nearest General Electric Apparatus Sales Office early in your planning. And write for GED-1966C, "Electrical Equipment for Process Industries" and GED-2244, "Engineering Services" to General Electric Co., Section 681-14, Schenectady 5, New York.

Engineered Electrical Systems for Refineries

GENERAL ELECTRIC



CONTROL for the gas turbine is completely centralized and requires very little actual supervision. After a few manual adjustments, the General Electric gas turbine automatically comes up to speed.

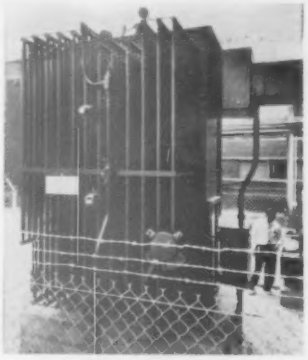


REPLACING six gas compressor drives, this General Electric 4000-hp induction motor application saved space, maintenance costs.

help lower refining costs

COMPACT G-E metal-clad switchgear helps protect and controls drives, requires little floor space, cuts installation costs.

INSTALLED faster because it was shipped completely assembled, 3750-KVA medium transformer supplies power to 4000-hp drive.



PROTECTED against corrosive atmosphere, fan cooled, explosion-proof, hot-oil pump motors need no protective housing.

Get More H.P.D.*
WITH PENROD

MORE HOLE PER DOLLAR

...that's what Penrod is set up to offer you. Whether your program calls for drilling on inland waters, offshore, or on land, you'll realize a big saving in the overall cost, including mud...with Penrod on the job.

CONTINUOUSLY IMPROVED EQUIPMENT AND METHODS

THOROUGHLY EXPERIENCED ORGANIZATION

INDIVIDUAL SUPERVISION OF EACH RIG

2-WAY RADIO ON ALL EQUIPMENT

MODERN HOUSING FOR OPERATING PERSONNEL

HIGH PRESSURE PUMPS ON ALL RIGS

USE OF MAXIMUM DRILL COLLAR WEIGHT

CALL, WIRE OR WRITE TODAY
FOR MORE HPD ON YOUR NEXT WELL

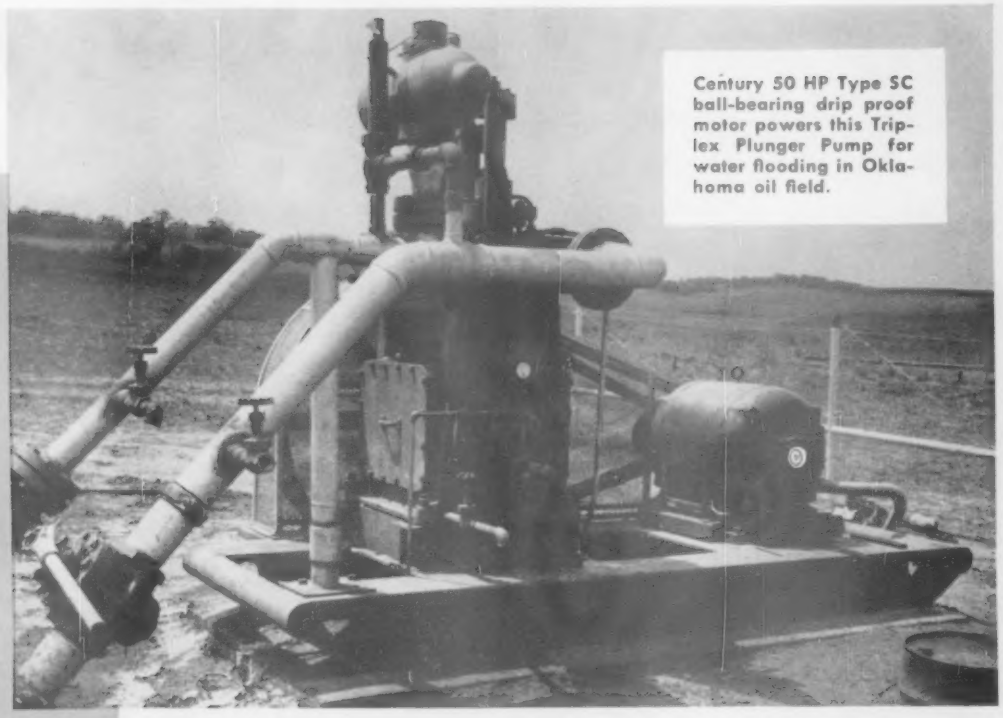
PENROD DRILLING COMPANY

D. K. (DEWEY) DAVIS, DRILLING SUPERINTENDENT

TELEPHONE 3-1601

418 MARKET STREET SHREVEPORT, LOUISIANA

PENROD LAND AND SEA DRILLING COMPANY



Century 50 HP Type SC ball-bearing drip proof motor powers this Triplex Plunger Pump for water flooding in Oklahoma oil field.

dependable power... for toughest oil field applications

Century Performance-Rated© MOTORS

For your oil producing operations, Century has a complete line of Performance-Rated motors. Choose just the right size, speed, torque, and frame for each specific job—no matter how tough the application. They are available with rodent-proof screens where required, and for hazardous atmospheres there are totally enclosed and explosion proof types.

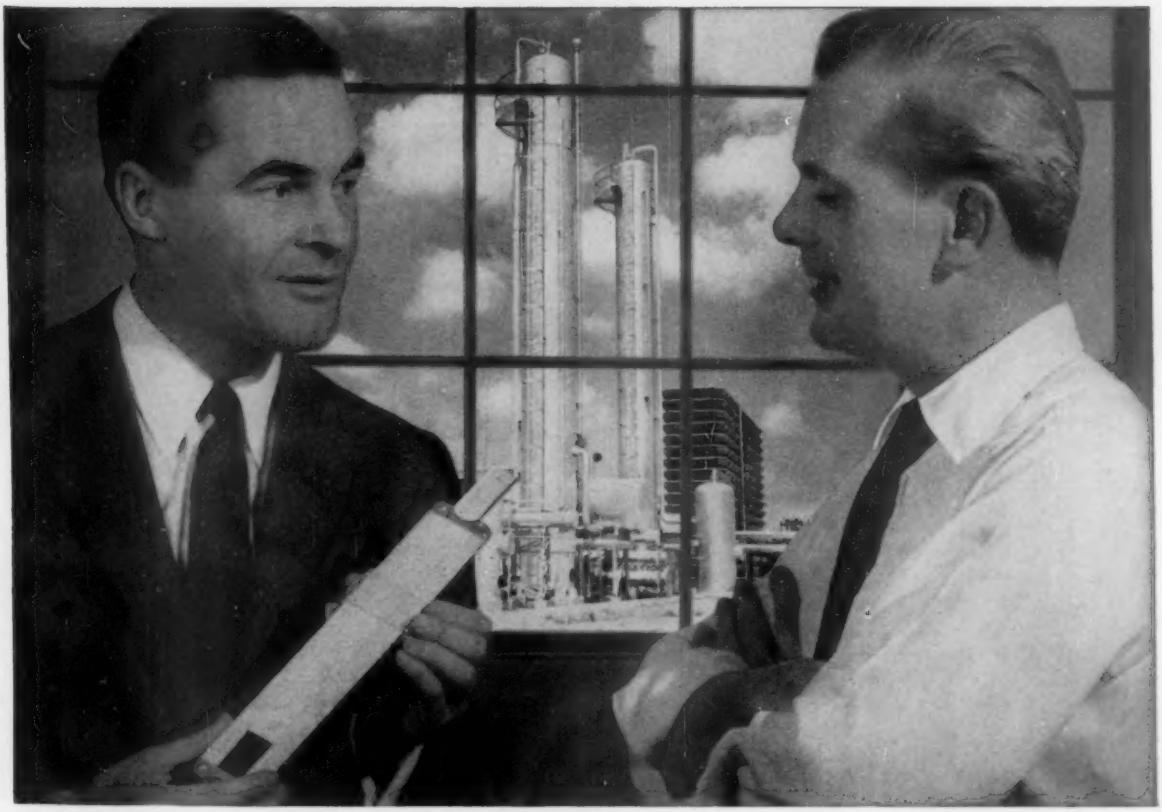
Outdoors or in the refinery, you get dependable power... in *precisely* the motor type you need. Call or write your supply store, or Century branch office.

Performance-Rated© MOTORS 1/20 to 400 H.P.

CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri • *Offices and Stock Points in Principal Cities*

86



You get more than gas treating chemicals from CARBIDE...

CARBIDE'S mono- or diethanolamine give you excellent removal of CO_2 and H_2S. By converting the extracted H_2S to sulfur or H_2SO_4, you benefit by recovering a valuable product—thus reducing your operating costs.

CARBIDE'S di- or triethylene glycol remove H_2O economically from gas streams. The low initial investment and low operating costs of glycol type plants provide minimum dehydration charges.

Plus Benefits

- Technical data gathered from 22 years experience producing and supplying gas treating chemicals. These data can help you in construction of new facilities, the enlargement of present equipment and in securing trouble free performance of existing plants.
- Technical help from field representatives and service laboratories.
- Fast delivery from warehouses located near major gas fields.
- Constant source of supply.

Find out for yourself how CARBIDE can help you. Write today to Carbide and Carbon Chemicals Company, Room 308, Department H, 30 East 42nd Street, New York 17, New York.

In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal. In Western Canada: Harrisons and Crossfield.

CARBIDE AND CARBON CHEMICALS

Carbide and Carbon Chemicals Company
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

WHAT USERS SAY
about Bucyrus-Erie Spudders

MICHIGAN, OPERATOR, 28-L: "Nicest rig I ever worked on . . . Bucyrus spudders really cut the hole and stand up well. They're easy to handle, too."

KANSAS, OPERATOR, 36-L: "Runs just fine . . . sure like those brake blocks. The 3-drum unit makes it simple to switch from baling, drilling, or running tube and rods. I also like the smooth running belt drive in place of noisy chain drive of competitive rigs."

ONTARIO, CANADA, CONTRACTOR, 60-L: "I like the 60-L's sturdy construction and easy operation. It's tops for this kind of drilling in sand and gravel surface where casing must be driven down almost 300 feet. It's easy to move, too."

OKLAHOMA, OWNER, 28-L: "We're very much pleased. This is the 26th well in 10 months continuous drilling, and the only repair expense has been $33 for two bearings."

WYOMING, OWNER, 36-L: "This rig has been in steady operation — drilling, cleaning-out, and tailing-in — for 5 years and has never been in the shop."

ILLINOIS, OWNER, 60-L: "In a more and more competitive business you can't make money and build a reputation with junk equipment . . . people get the wrong impression. The finest kind of modern machinery is the soundest investment a man can make."

PENNSYLVANIA, OWNER, 60-L: "Past record of our 28-L sold us on the 60-L before we even used it."

COLORADO, OWNER, 48-L: "Last word in drilling with cable tools."

These are actual quotes from users* of Bucyrus-Erie spudders on various drilling contracts throughout the country. In state after state, these experienced oil well contractors and operators say basically this: "We recognize the value of Bucyrus-Erie's close attention — during manufacture — to all the things that assure outstanding quality. The resultant fine performance, long-life construction, easy operation, mobility, and dependability of these spudders are the things that put the extra profits in our contracts."

Consider these quotes carefully. Then see your nearby distributor for the complete story on Bucyrus-Erie spudders. There's a size to fit your drilling needs.

*Names on request

31556

60-L 1,500-ft., top-to-bottom; 2,000-ft., servicing

28-L 2,500-ft., top-to-bottom; 3,000-ft., servicing

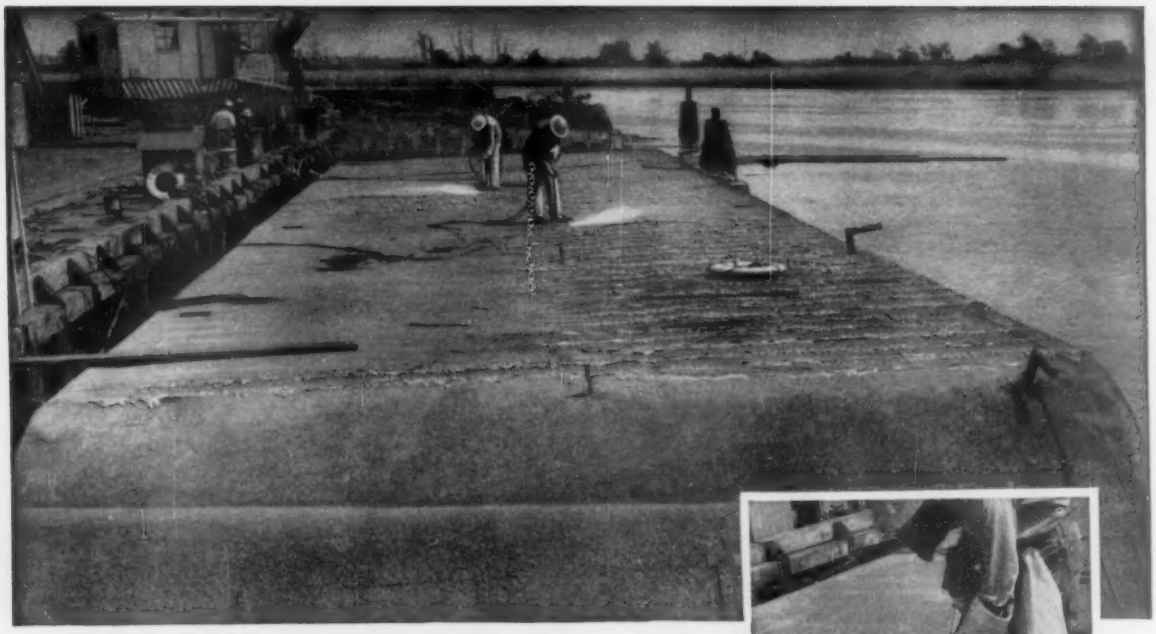
36-L 3,500-ft., top-to-bottom; 4,000-ft., servicing

48-L 6,000-ft., top-to-bottom; 7,000-ft., servicing

BUCYRUS ERIE

South Milwaukee, Wisconsin

FIRST with the FINEST in Spudders



This C-51 deseaming blowpipe opens transverse plate welds in steel barge bottoms 7 times faster than the previously used process.

Barges get new lease on life...

FOR 70% LESS COST

Deseaming blowpipes have cut the time required to remove these steel barge bottoms from 4 days per barge, to only 1½—and cut costs $500 per barge....

In this operation, the barges were rolled over in the water. Bottom plates were deseamed and removed, and then new plates UNIONMELT welded in position. Before removing the old plates, it was necessary to "open" seam welds, plug welds, and rivets. The deseaming blowpipes did this work with maximum speed and economy—and with minimum nicking into the support members beneath the plates.

Deseaming blowpipes operate with a low-velocity oxygen stream, and make a wide pass in metal at high speeds. The depth of penetration is controlled by regulating oxygen pressure. Lightweight, easy to handle deseaming blowpipes are speeding production and repair operations throughout industry.

For more information on this or any other of LINDE's modern, money saving processes, call your local LINDE representative. Start saving now, call him today.

Linde Air Products Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
Offices in Other Principal Cities
In Canada: LINDE AIR PRODUCTS COMPANY
Division of Union Carbide Canada Limited, Toronto
(formerly Dominion Oxygen Company)

Linde Trade-Mark

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COOLING TOWER POWER

GOES HIGH HAT

Putting the fan cylinder to work, making it a functional part of the tower, is Marley's latest achievement that brings a new look to industrial cooling towers. As an integral part of Marley tower power the new **VL** (vertically laminated) **Fan Cylinder*** has a job to do beyond merely discharging exhaust vapor at high elevation to minimize the hazard of fogging . . . IT AMPLIFIES FAN EFFICIENCY AND COOLING PERFORMANCE.

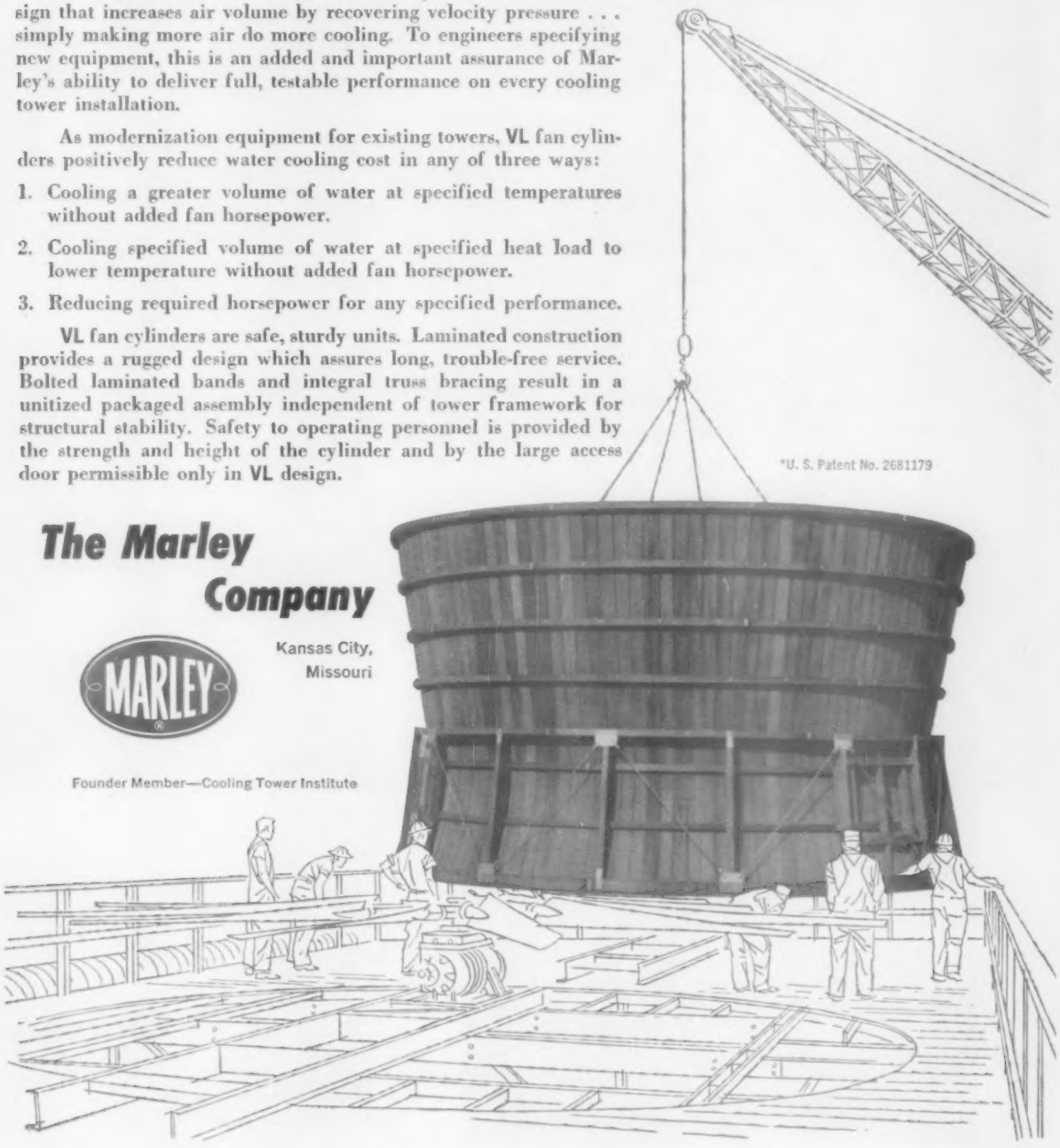
The distinctive **VL** contour is dictated by tested, scientific design that increases air volume by recovering velocity pressure . . . simply making more air do more cooling. To engineers specifying new equipment, this is an added and important assurance of Marley's ability to deliver full, testable performance on every cooling tower installation.

As modernization equipment for existing towers, **VL** fan cylinders positively reduce water cooling cost in any of three ways:

1. Cooling a greater volume of water at specified temperatures without added fan horsepower.
2. Cooling specified volume of water at specified heat load to lower temperature without added fan horsepower.
3. Reducing required horsepower for any specified performance.

VL fan cylinders are safe, sturdy units. Laminated construction provides a rugged design which assures long, trouble-free service. Bolted laminated bands and integral truss bracing result in a unitized packaged assembly independent of tower framework for structural stability. Safety to operating personnel is provided by the strength and height of the cylinder and by the large access door permissible only in **VL** design.

*U. S. Patent No. 2681179



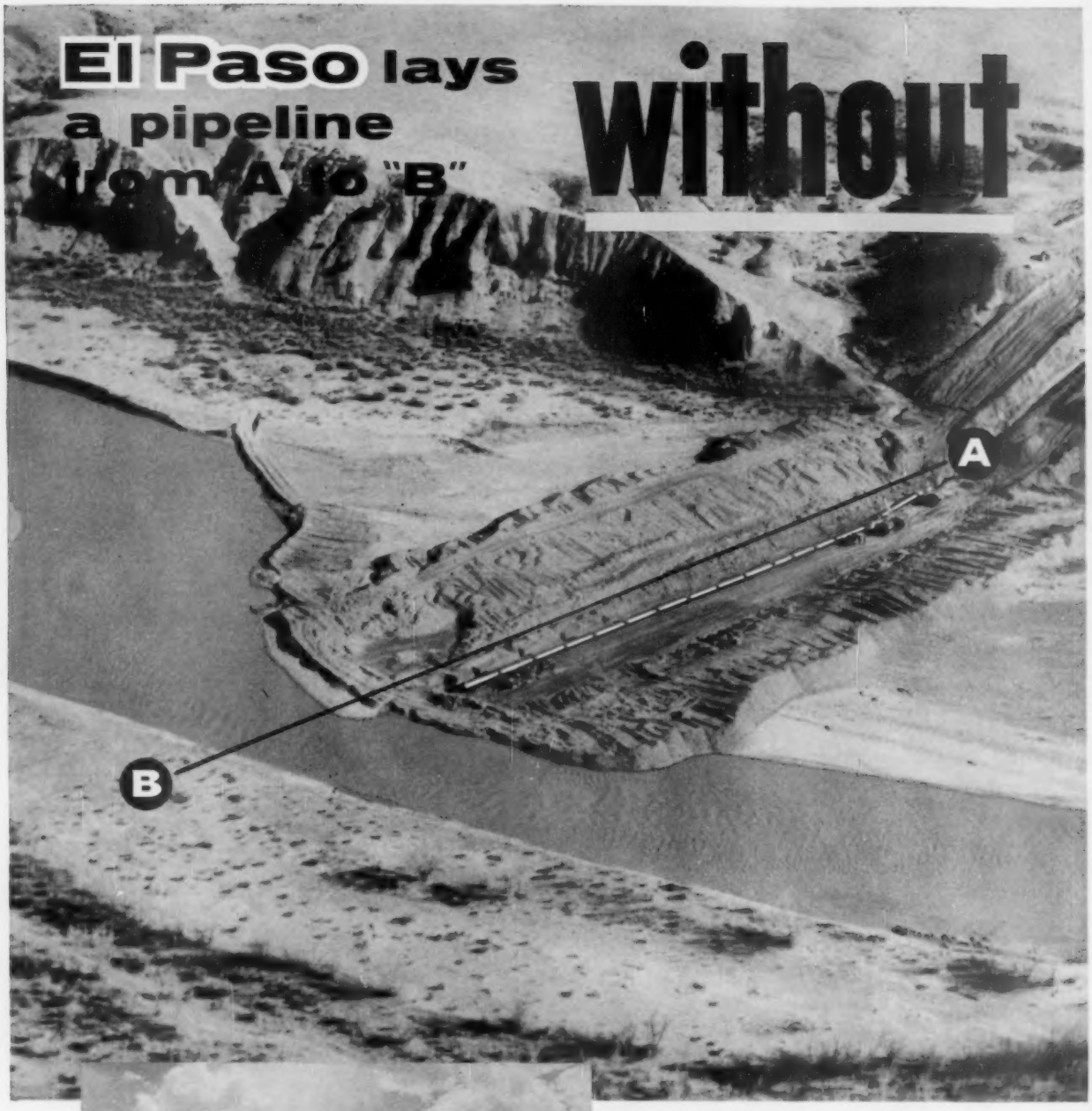
The Marley Company

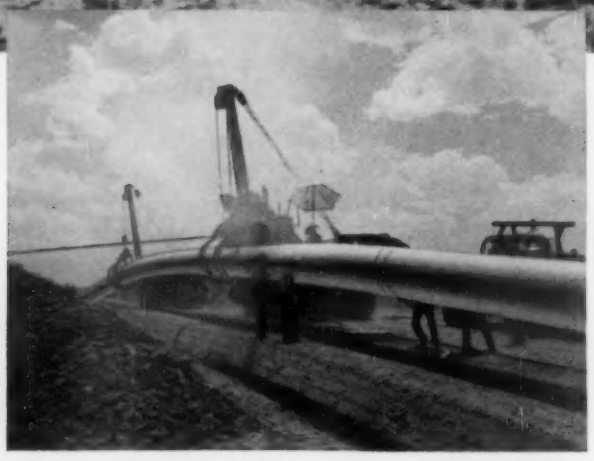
Kansas City, Missouri

MARLEY

Founder Member—Cooling Tower Institute

El Paso lays a pipeline from "A" to "B" without





El Paso spreads cross the San Juan river in northern New Mexico. Pipe was first laid to the edge of the main channel. Then an earthen dam was built upstream. Water flow shifted over the section of line near the far bank and the 800-foot crossing was completed. Trench depth averaged 20 feet, pipe was anchored every 40 feet with tie-down clamps bolted 9 feet deep in the shale.

Laying the 34-inch pipe across the red desert of the Navajo Indian Reservation of Northern New Mexico.

From San Juan, New Mexico, the line travels across the red desert of the Navajo Indian Reservation of Northern New Mexico and through the Foothills of the San Francisco Mountains in northern Arizona near Flagstaff. Near Holbrook, Arizona, it extends under the little Colorado River (approx. 500-ft. crossing). At its terminus, the line stretches 1,100 feet across the Colorado River on a pipeline suspension bridge being built jointly by El Paso and Pacific Gas and Electric Company.

crossing the river!

THEY PUSHED THE RIVER ASIDE! El Paso Natural Gas Company laid their line to the edge of the main channel first, then temporarily diverted the river and used dry land methods to lay the pipe through the main channel. El Paso spreads report the crossing went without a hitch, and was less expensive than going under or over the river by usual methods.

Completed line to increase capacity by 450,000,000 cubic feet per day

Taking approximately 350,000,000 cubic feet daily from the San Juan Basin and another 100,000,000 cubic feet from the Permian Basin, the San Juan-Topock project, as it's called, will increase the company's total deliveries to over two and one-third billion cubic feet daily. Begun in early 1956 and scheduled for completion in early 1957 the new line will supply an additional 350 million cubic feet daily to customers in California and an additional 100 million cubic feet daily to customers in Arizona, New Mexico, Texas and Nevada. The 34-inch line, for the most part, will loop two existing lines (24 and 30-inch) which extend from the San Juan Basin to Topock on the California border.

A. O. Smith supplying 34-inch pipe for two-thirds of 338-mile project

Approximately 224 miles of 34-inch pipe was shipped to El Paso spreads from A. O. Smith Corporation of Texas' plant at Houston. For almost 30 years A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

Through research A.O. Smith *. . . a better way*

A.O.Smith
CORPORATION

TUBULAR PRODUCTS DIVISION
Milwaukee 1, Wisconsin

Chicago 4 • Dallas 2 • Houston 2 • Los Angeles 17 • Midland 5, Texas
New Orleans 12 • New York 17 • Pittsburgh 19 • Tulsa 3
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Have You a Special Heat Transfer or Chiller Problem?

My Problem Is Surface Fouling!

Vogt has the answer in the positive *flow-thru* Scraped Surface Exchanger. Surfaces are swept clean by the rotating scraper action, eliminating the headache of fouled heat transfer surfaces.

We Have A Tough Crystallization Problem!

Because Vogt Scraped Surface Exchangers maintain uniform heat transfer rates crystallization is under control at all times. The rotating blades free the crystals from the walls and they are discharged as a slurry.

Our Product Must Be Mixed As It Flows!

Chemical Processors are particularly happy with the Vogt Scraped Surface Exchanger, because the product is thoroughly mixed by the rotating scraper blades as it flows.

Our Solvents are Dangerous to Use - Expensive to Lose!

Vogt Scraped Surface Exchangers are closed, pressure-type systems which permit the use of flammable, volatile and expensive solvents with complete safety and no danger of solvent loss.

Vogt

Has the answer in its Scraped Surface Exchangers

Send for Bulletin PE-1 today. Address Dept. 24AR10.

OTHER VOGT PRODUCTS: Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making and Refrigerating Equipment.

HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1, KY.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati, San Francisco

Various sections of the 1000 mile American Louisiana Pipeline are coated with three types of coal tar enamels: Bitumastic® No. 2 Enamel for mild climates, Bitumastic 70-B Enamel for cold locales, and Bitumastic Hi-Melt Enamel for the hot portions after compressor stations.

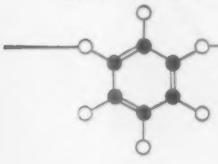
Most of the big pipeline jobs are protected with **COAL TAR* ENAMEL**

No doubt about it, coal tar enamel is getting the nod from men responsible for corrosion prevention on today's pipelines. They know from *experience* that coal tar is the best investment for long-term protection of underground lines.

Coal tar enamel has inherent characteristics that explain its unique superiority as a pipeline coating. First and foremost is its water-resistance: tests have proved that coal tar enamel resists water better than any other commonly-used coating material.

Naturally, this excellent resistance to the absorption of water makes coal tar a more effective insulating material, an important factor in cost where complementary cathodic protection is used. Its other qualities of chemical inertness and toughness enable coal tar to resist deterioration from the action of soil chemicals and soil stresses.

Only Koppers produces Bitumastic coatings—a complete line of coal tar enamels to meet every pipelining need, from hot-line coating at compressor stations to sub-zero conditions. Write or call your nearest Koppers office; a representative will be glad to give you the complete story on effective pipeline protection with Bitumastic Enamels.



This is a representation of the aromatic benzene ring, heart of coal tar's molecular structure, and key to its unexcelled performance as a pipeline coating.

KOPPERS

BITUMASTIC
REG. U. S. PAT. OFF.
COAL TAR ENAMELS

Now . . . most power of the low-priced 3—

New DODGE *PowerGiants*

1957 line-up gives you up to 232 hp.

Dodge tops the low-priced field in V-8 power by a big margin—actually delivers as much as *31% more!* This *extra* power in reserve saves engine strain . . . wear . . . excessive repairs. What's more, Dodge V-8's use *regular* gas, help keep your cost per ton-mile *down!*

Extra payload capacity. You can haul more—up to 73% more in the 300 model pick-up, for example.

Extra handling ease. Exclusive push-button automatic transmission*! Sharpest turning and easiest steering in the industry!

See the new *Power Giant* line-up now at your Dodge dealer's. You'll see features that prove it pays to get your Dodge dealer's deal before you decide on *any* truck.

**Available on all low-tonnage and forward-control models.*

DODGE TRUCKS

WITH THE *FORWARD* LOOK

DODGE meets your hauling needs!

Conv. Models	Max. G.V.W.	Max. G.C.W.	Max. V-8 HP.
100	5,100 lbs.	—	204
200	7,500 lbs.	—	204
300	8,800 lbs.	—	204
400	15,000 lbs.	26,000 lbs.	197
500	18,000 lbs.	32,000 lbs.	197
600	21,000 lbs.	35,000 lbs.	197
700	23,000 lbs.	45,000 lbs.	216
800	25,000 lbs.	55,000 lbs.	222
900	30,000 lbs.	65,000 lbs.	232
Forward-Control Models			
P300	9,000 lbs.	—	204
P500	15,000 lbs.	—	204
C.O.E. Models			
C500	18,000 lbs.	32,000 lbs.	197
C600	21,000 lbs.	35,000 lbs.	197
C700	22,500 lbs.	45,000 lbs.	216
Tandem Models			
T700	32,000 lbs.	45,000 lbs.	216
T800	36,000 lbs.	55,000 lbs.	222
T900	46,000 lbs.	65,000 lbs.	232

Pick-up model 100

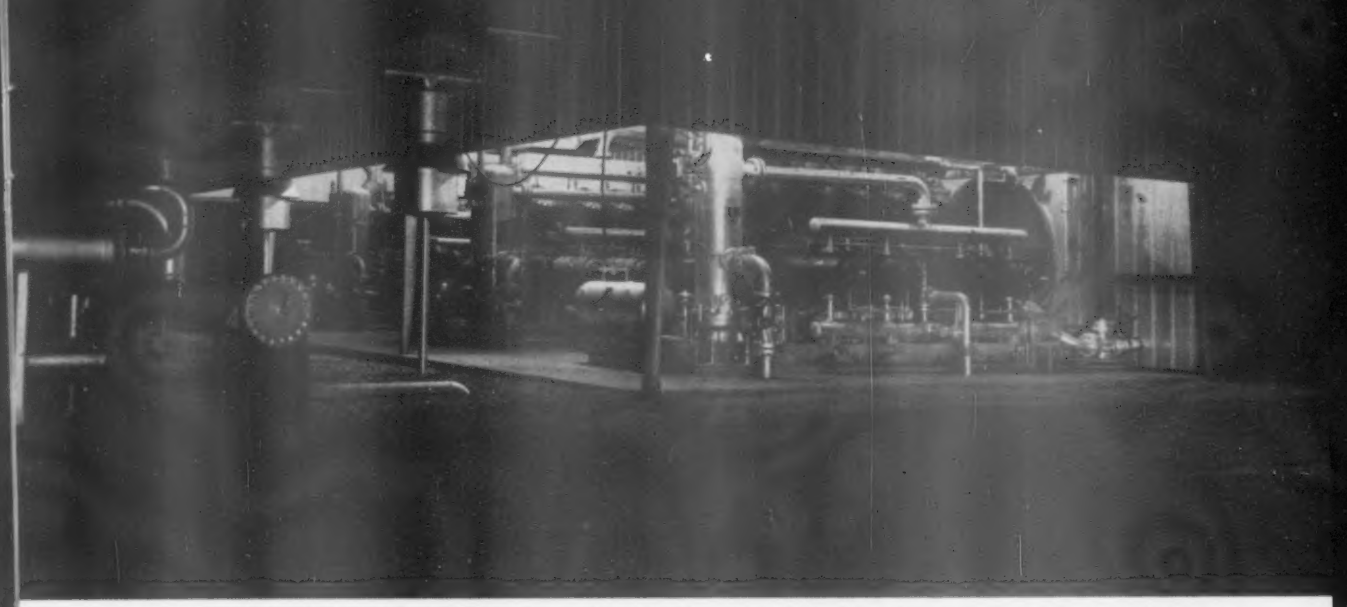
Forward-Control model 300

C.O.E. tractor model 700

BEAIRD-INGERSOLL-RAND

Packaged Compressor Plant

Lowest Cost Per Horsepower Installed



NATURAL GAS AND OIL COMPANY'S SLIGO FIELD STATION—equipped with three Beaird-Ingersoll-Rand 10SVG 550 h.p. packaged compressors, Young Radiators with lubricating oil coolers, gas coolers and all necessary controls. Other sizes 110 to 660 h.p.

Natural Gas and Oil Company has twice expanded this compressor station in Sligo Field, Louisiana. Originally it was equipped with a single Beaird-Ingersoll-Rand 10SVG 550 h.p. compressor. In designing the station the engineers provided the space and piping to accommodate units that would be added on as needed. Now picking up gas from 24 low pressure wells at 650 psig. the station is boosting from 40 mmcfd to 50 mmcfd to transmission lines at 1050 psig. The last unit installed in August of this year will enable the station to follow the pressure on down to 200 psig. without change from single-stage operation. At this point in production the units will be changed in the field to two-stage operation. And finally as the field nears depletion, one or two of the compressor plants may be transferred as a complete package to another site, leaving the remaining plant to complete production.

Let us show you the versatility possible with packaged compressors designed for your production needs.

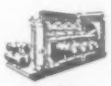
Versatile Packaged Compressors–

SOLUTION FOR EXPANDING STATION

BEAIRD

MACHINING
MANUFACTURING
STEEL WAREHOUSE

THE J. B. BEAIRD COMPANY, INC.



PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

SHREVEPORT, LOUISIANA • Sales Offices: *Dallas, Houston, Corpus Christi and Midland, Texas • New Orleans, Louisiana • Tulsa, Oklahoma • Denver, Colorado • Los Angeles, California, and Cie. Ingersoll-Rand, Paris, France*

CONTROLLED QUALITY

COMPLETE STRESS RELIEVING ON BEAIRD LPG-NH3 STORAGE TANKS

Engineers will tell you that stress relieving produces safer, more dependable storage vessels by eliminating internal stresses set up during forming, rolling and welding of tank sections. This important safety feature is available from Beaird, Shreveport, where one of the South's largest stress relieving furnaces is in operation.

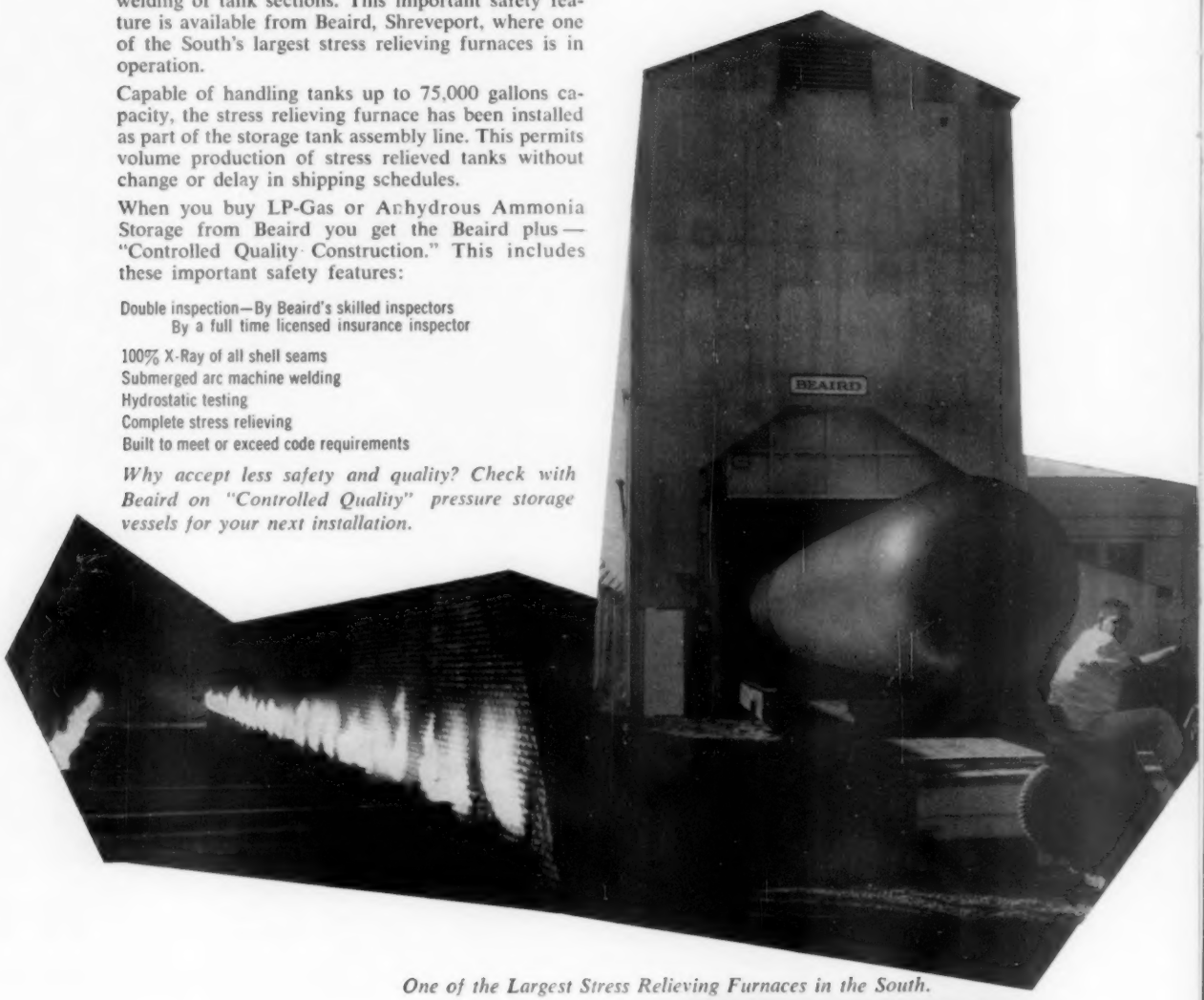
Capable of handling tanks up to 75,000 gallons capacity, the stress relieving furnace has been installed as part of the storage tank assembly line. This permits volume production of stress relieved tanks without change or delay in shipping schedules.

When you buy LP-Gas or Anhydrous Ammonia Storage from Beaird you get the Beaird plus—"Controlled Quality Construction." This includes these important safety features:

Double inspection—By Beaird's skilled inspectors
By a full time licensed insurance inspector

100% X-Ray of all shell seams
Submerged arc machine welding
Hydrostatic testing
Complete stress relieving
Built to meet or exceed code requirements

Why accept less safety and quality? Check with Beaird on "Controlled Quality" pressure storage vessels for your next installation.



One of the Largest Stress Relieving Furnaces in the South.

BEAIRD

THE J. B. BEAIRD COMPANY, INC.

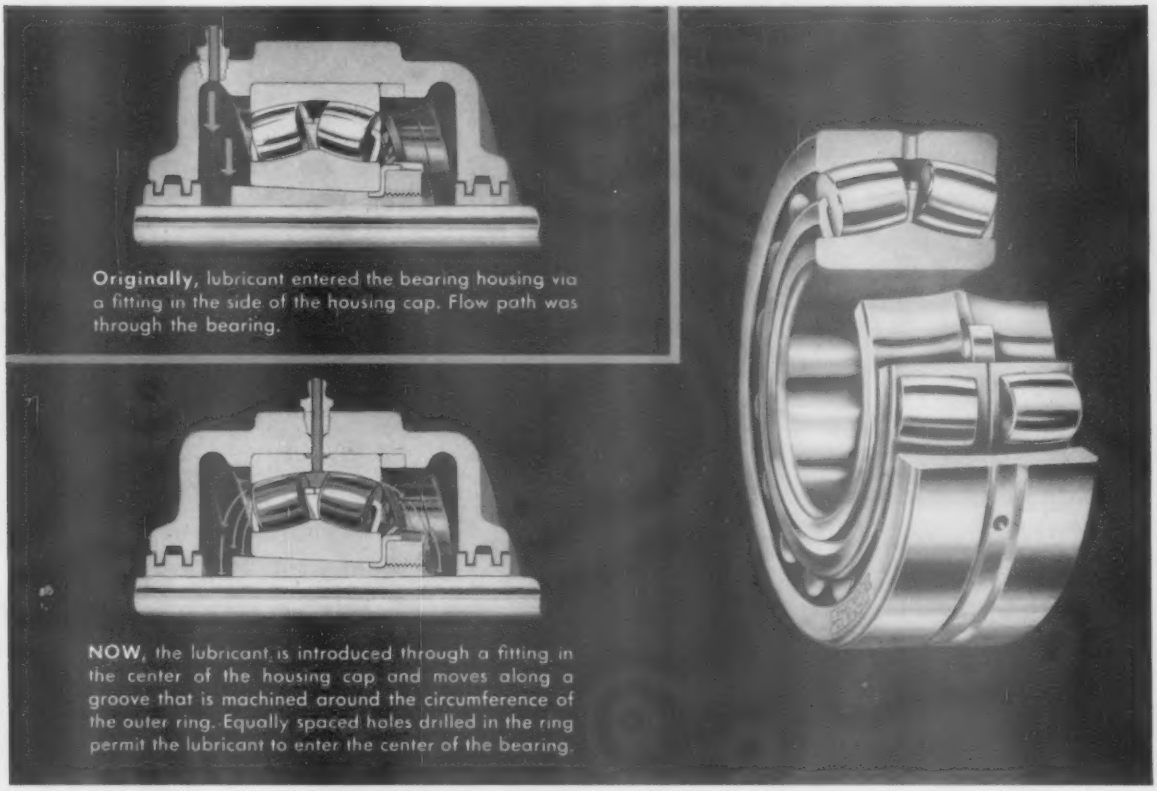
LP-Gas | Anhydrous Ammonia | Pressure Bulk Storage | Transports | Fitting Station

Shreveport, Louisiana
Clinton, Iowa
Stockton, California

The World's largest manufacturer of LP-Gas systems.

At No Extra Charge . . . A MAJOR IMPROVEMENT

IN LUBRICATING SPHERICAL ROLLER BEARINGS



Originally, lubricant entered the bearing housing via a fitting in the side of the housing cap. Flow path was through the bearing.

NOW, the lubricant is introduced through a fitting in the center of the housing cap and moves along a groove that is machined around the circumference of the outer ring. Equally spaced holes drilled in the ring permit the lubricant to enter the center of the bearing.

Nobody but SKF Offers This to You on Spherical Roller Bearings

Once again **SKF** offers another important innovation in spherical roller bearing design. Available in spherical roller bearings 140 mm (5.5118") O.D. and larger, this feature represents a still further improvement to the proven **SKF** Type "C" Spherical Roller Bearing.

The new design allows the lubricant to enter at the *center* of the bearing and move outwardly – completely covering all working surfaces. Old lubricant is flushed away from the bearing and, with it, any abrasive dust, dirt, moisture, or other impurities.

You can use this improved bearing in your existing housings simply by moving the lubrication fitting to the center.

Here again is an example of how **SKF** helps you to obtain longer bearing life, at no added cost. Send for Bulletin No. 443 for complete details. 7751

SKF®

EVERY TYPE—EVERY USE

- *Ball Bearings*
- *Cylindrical Roller Bearings*
- *Spherical Roller Bearings*
- *Tapered Roller Bearings* (Tyson®)

*Reg. U.S. Pat. Off. Tyson Bearing Corporation

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

IT'S BRAND NEW!

The O-C-T UNIVERSAL TUBING HEAD

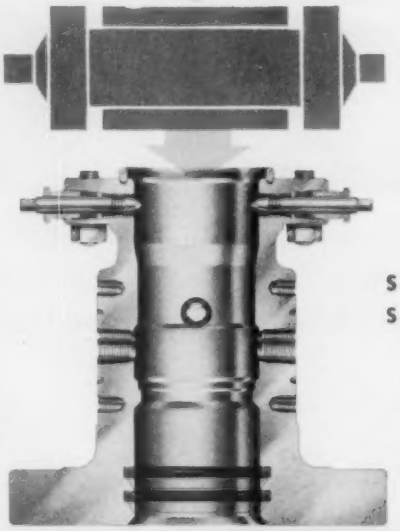
. . with 6 interchangeable dual string and single string tubing hangers!

The new OCT universal tubing head is available with a complete range of interchangeable tubing hangers for both dual and single strings. Last minute changes in completions can be made without changing tubing heads or using special attachments. If only one producing sand is found in a proposed dual well, the well may be completed by using a single string hanger. If a second sand is found in a well originally scheduled for single completion, the well may be completed with a dual hanger instead of the single hanger originally contemplated.

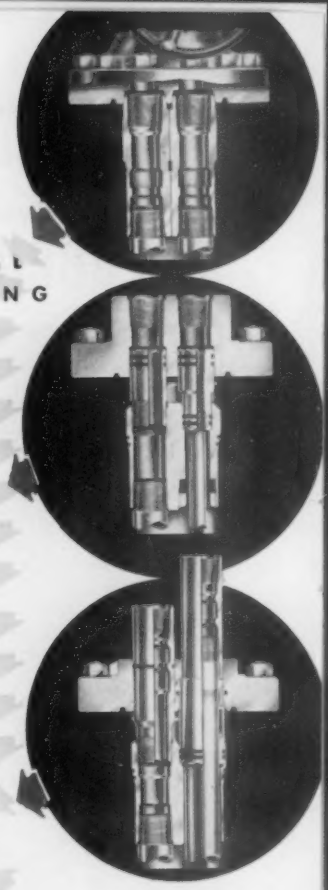
The OCT universal tubing head is equipped with two retractable aligning screws which are used to align the dual hanger with respect to the head itself. These aligning screws are retracted when single string hangers are used.

Safety is assured, since all hangers are run through, landed and locked in place prior to the removal of blowout preventers. Once the head has been installed, all seals can be field tested through test ports located in the flanges.

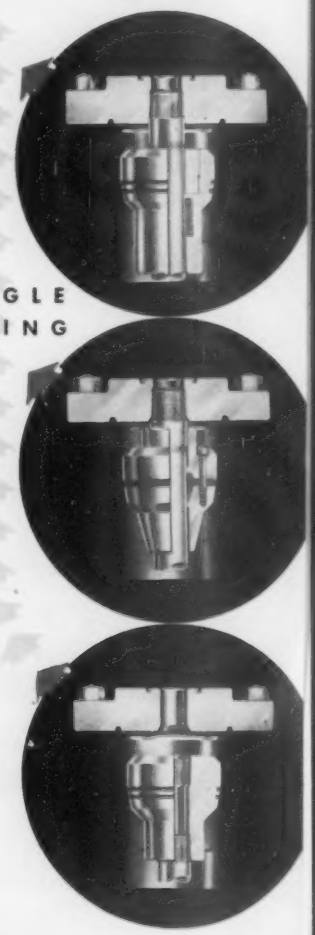
This universal head is available in 600 through 2900 series and flange sizes from 6" to 10". If an operator does not desire to remove the existing tubing head in order to dually complete a well, an adapter is available.



DUAL STRING



SINGLE STRING



Any of six interchangeable hangers may be landed and locked in place through blowout preventers

All seals may be tested by a single application of pressure through a test port in the top adapter flange

O·C·T

OIL CENTER TOOL CO.

Export Representatives: South America — East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

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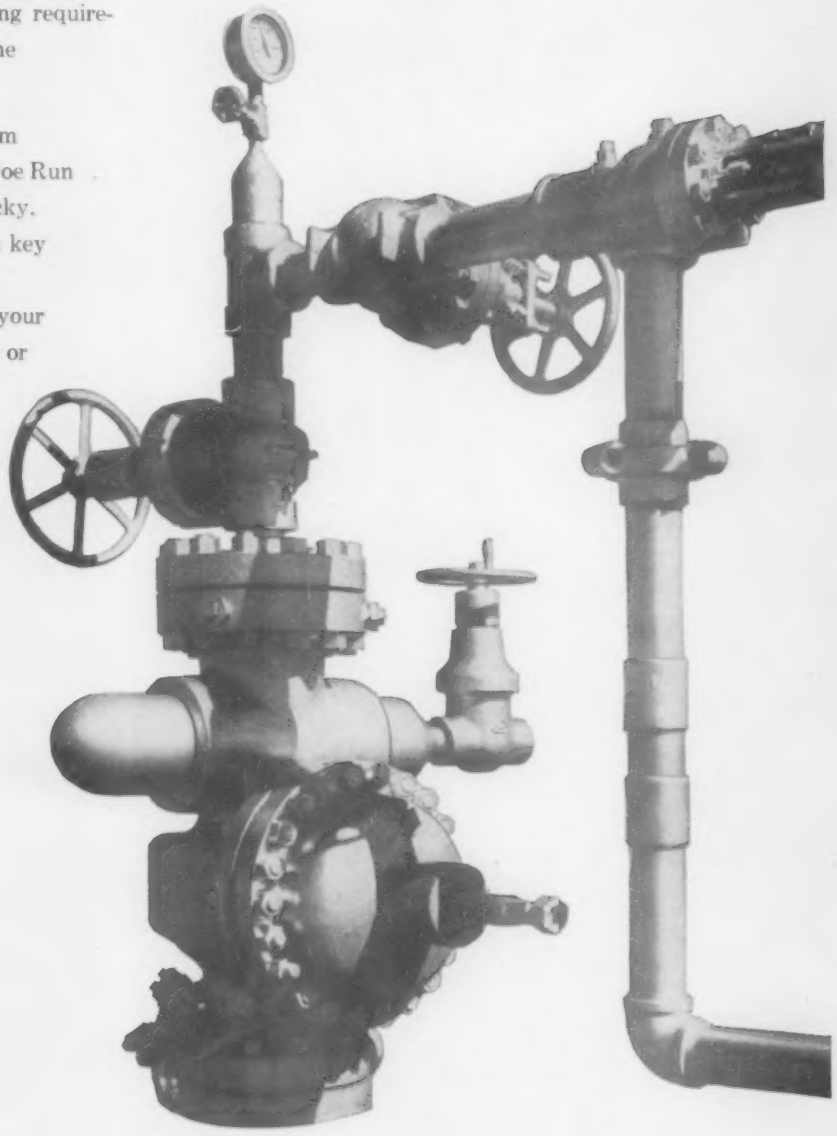
. . . in the quantity and quality specified and shipped to meet your operating requirements for gas scrubbing and the absorption of acidic gases.

Tank car, tank truck, and drum shipments are made from the Doe Run Plant at Brandenburg, Kentucky. Local stocks are maintained in key industrial areas. For technical information and samples, call your Olin Mathieson representative or write today.



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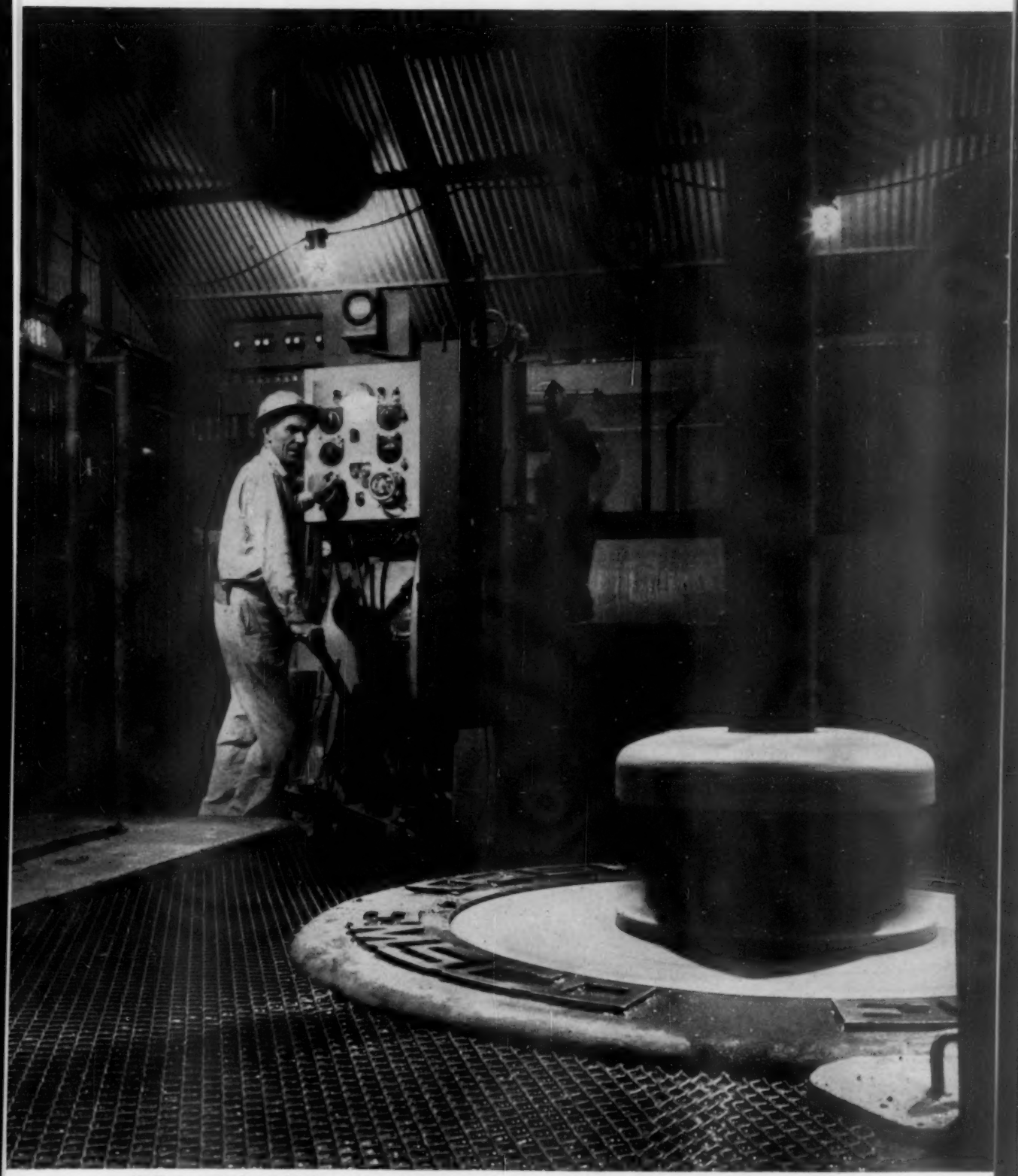
ORGANICS: Ethylene Oxide · Ethylene Glycols · Polyethylene Glycols · Glycol Ether Solvents · Ethylene Dichloride · Dichloroethylether · Formaldehyde · Methanol Sodium Methylate · Hexamine · Ethylene Diamine · Polyamines · Ethanolamines · Trichlorophenol · Surfactants

A landlubber goes to sea . .



Driller's control stand is located beside draw works and just behind rotary table. From this point the driller can oversee every operation. From one panel he has complete control of all Diesel-electric equipment.

. . BIG CHIEF USES ELECTRO-MOTIVE POWER on first offshore rig

Big Chief Drilling Company of Oklahoma City was a landlubber for twenty years before plunging into offshore drilling. More than a year was spent studying offshore problems, designing equipment before launching Rig 34. Why they picked Electro-Motive Diesel-Electric Power is told here:

Deck cost cut to minimum

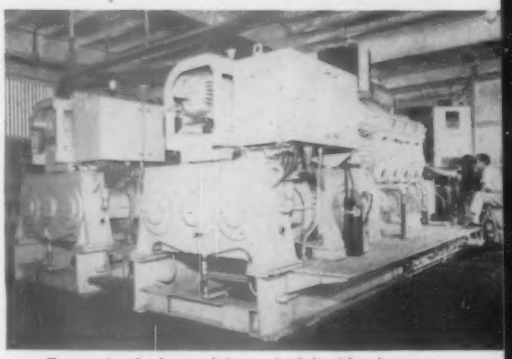
Platform deck area measures only 88 by 145 feet. Living quarters, fuel storage, mud, water, pipe racks, etc., alone take 88 by 110 feet. In the space left, (35x88) Big Chief's engineers had to pack a complete rig and provide for location of six wells. Solution: Electro-Motive Power with flexible cables permitted locating components in a space-saving three story design.

Big power, simple control

Two 900-hp GM Diesel engines driving four 500-kw dc generators supply power to 625-hp drive motors on mud pumps, rotary and draw works. Coupled with this power is a simple and accurate control system that provides smooth and rapid acceleration of loads with positive control of speed and torque. Result: flexible control for faster, lower cost drilling.

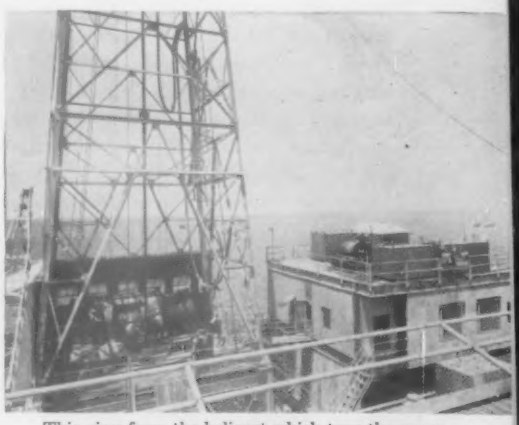
Matched components

Electro-Motive Power is a complete drilling power system. Each component was designed and built to work together—one manufacturer—one source of responsibility. The tested dependability and widespread acceptance of this power is proof of its drilling advantages on land or water. For your convenience there's an Electro-Motive Representative located in every major drilling area.



Conveniently located in a shed beside the mast are the two 975-hp generating sets. Each drives two 500-kw dc generators and comes complete on skids with controls and cooling system. Note how cables to drive motors are neatly routed on overhead trays.

Two 625-hp dc drive motors supply power for draw works. Generators are connected to these motors through electric cables, permitting complete flexibility of arrangement. In fact, the entire Diesel-electric system can readily be adapted to any platform.



This view from the heliport which tops the crews quarters shows the simple and efficient layout of Rig 34. At left is the driller's stand, at right the engine generator shed. Below deck are pumps and tanks for mud, fuel and water.

ELECTRO-MOTIVE DIVISION
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Petroleum industry sales offices: Tulsa, Oklahoma; Houston, Texas; Dallas, Texas; Morgan City, Louisiana; Pasadena, California.

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Because

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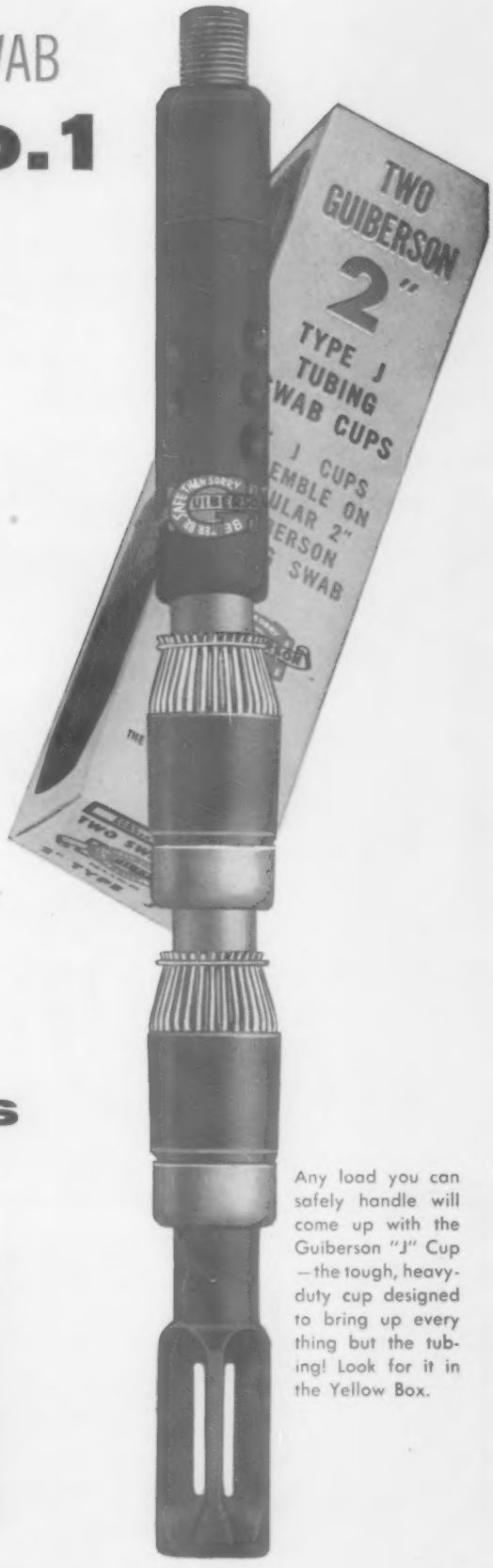

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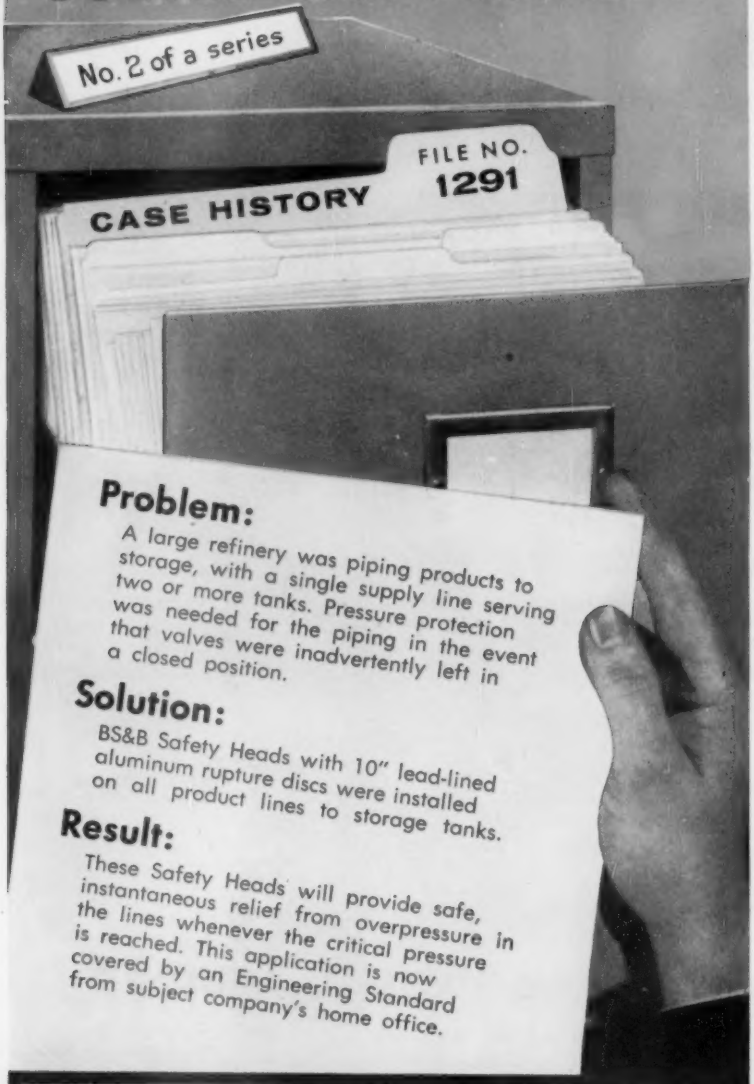

Problem:

A large refinery was piping products to storage, with a single supply line serving two or more tanks. Pressure protection was needed for the piping in the event that valves were inadvertently left in a closed position.

Solution:

BS&B Safety Heads with 10" lead-lined aluminum rupture discs were installed on all product lines to storage tanks.

Result:

These Safety Heads will provide safe, instantaneous relief from overpressure in the lines whenever the critical pressure is reached. This application is now covered by an Engineering Standard from subject company's home office.

OVER 60 YEARS — BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

Have you considered what BS&B Safety Heads can do to improve the safety of **your** pressurized equipment? Complete information on the many possible applications of BS&B Safety Heads will be sent on request.

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They Say—

A Good Year in Venezuela

"The year for the petroleum industry in Venezuela was highlighted by the granting of new oil concessions, the first since 1945.

"Since the new development concessions run for 40 years, the government's step has been generally interpreted to mean that the economic policies which have enabled the country to develop its oil resources at such a rapid rate will not be changed.

"Venezuela traditionally has provided a highly attractive investment climate for capital from abroad, and the concessions action of the government was considered a reaffirmation of that policy.

"One immediate effect of the grants was to bring a large number of oil companies into Venezuela, increasing the competition in the industry. Some 35 new companies have registered to do business since the concessions announcement."

H. W. Haight, president, Creole Petroleum Corp.

Thirty Pounds of Red Tape

"Fifty per cent of the natural gas that is marketed in Texas is consumed inside the state. The other 50 per cent provides heat and power for private and industrial consumption in other states. But there is a growing disposition among Texas gas finders to quit searching for gas and hold what they have found until one of two developments occurs.

"The first is arrival of a state market for as much gas as Texas can yield. The second is the abolition of federal control of prices for gas sold at the wellhead to the companies which put it into interstate commerce.

"If the small independent finders of natural gas, awaiting the first development and despairing of the second, follow the policy of some of the large companies, it is entirely possible that within a few years—maybe 10—the outside communities that are dependent for heat and power on natural gas will become hardship cases.

"The Humble company, for example, has capped hundreds of billions of cubic feet (thus withholding this from the interstate market). And many independent finders, buried under the mountains of paper work they must do for the Federal Power Commission before

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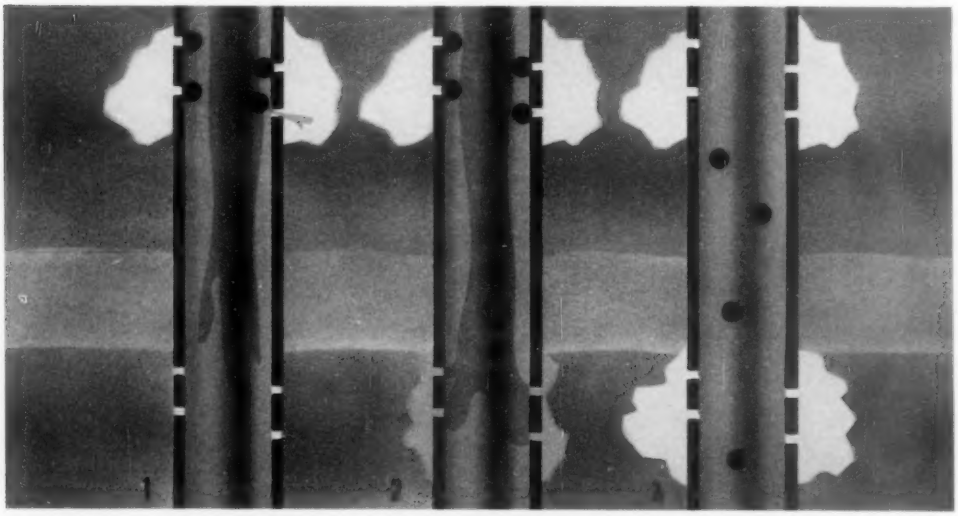
Proved Performance with Perforation Ball Sealers.....

- **In more than 450 wells throughout the Southwest**
- **In all types of formations**
- **When used with all types of fracturing and acidizing fluids—from fresh water to lowest gravity lease crudes**
- **With all types of perforations, bullets and jet**
- **Under all well conditions—multiple and single zone**
- **In wells with 10 feet of perforations to 400 feet of perforations**
- **Using as few as 20 balls and as many as 1,000**

Perforation Ball Sealers—introduced by The Western Company only a few months ago—have proved the most effective, yet simple, means of bringing complete treatment to the entire perforated section on one set-up. Their ball-valve action temporarily seals off perforations opposite the most permeable zone,* diverting treating fluids into the tighter zones to insure complete break-down and treatment of the entire section.

Ball Sealers cut to a minimum the use of down-hole tools and reduce pressure differential across the cement blanks. They allow break-down of the entire perforated section with greatest economy, whether only 10 feet in length or several hundred, single or multiple zones, close together or widely separated. Treatment control is provided even in cases where no other control mechanism can be used.

* Sealing action and self-removal from perforations verified by Pittsburgh Testing Laboratory. Details on request.



1. Perforation Ball Sealers seal perforations opposite zone that is fully treated, diverting fluid into other perforated section.
2. Break-down and treatment of less permeable zone is completed as balls give positive seal on upper zone.
3. Pressure is reversed and balls drop from perforations to bottom of the well to be left or recovered by bailer if desired.

PERFORATION BALL SEALERS GIVE EFFECTIVE TREATMENTS—

Effectiveness of treatments using Perforation Ball Sealers is proved by radioactivity tracer logs run in many wells. Complete break-down and treatment of the entire perforated section on a single set-up provides the most effective treatment for greatest results.

Here are a few examples of Perforation Ball Sealer effectiveness:

Location County	Formation	Perforations	Sealers	Previous Production	Present Potential	Offset Potential*
Andrews, Texas	San Andres	6 sets total 118 ft.	375	13 BOPD pumping	120 BOPD flowing	50 BOPD pumping
Crane, Texas	Dune Grayburg	1 set total 100 ft.	444	new well	400 BOPD flowing	100 BOPD pumping
Stephens, Okla.	Tussey Woodmansee	4 sets total 84 ft.	250	new well	2044 BOPD	300 BOPD
Carter, Okla.	Tussey	2 sets total 40 ft.	300	48 BOPD pumping	604 BOPD flg. & ppg.	50 BOPD pumping
Carson, Texas	Wolfcamp Dolomite	4 sets total 47 ft.	315	new well	432 BOPD	336 BOPD
Hutchinson, Texas	Wolfcamp Dolomite	2 sets total 64 ft.	240	new well	105 BOPD pumping	72 BOPD pumping

* "Offset Potential" is from offset wells completed in the same formations, with substantially the same number of perforations and intervals, and treated using conventional fracturing methods without Ball Sealer control.

PERFORATION BALL SEALERS MEAN ECONOMY—

Fracturing and acidizing treatments using Perforation Ball Sealers have resulted consistently in savings of several thousand dollars per well in treatment costs. Following is a comparison of completion costs of wells for one operator in the same field in Winkler County, Texas. Wells in black were treated by conventional methods, involving use of packers and stage treatments. Those in red were completed with Ball Sealers. Wells averaged nine perforated intervals in the same formation.

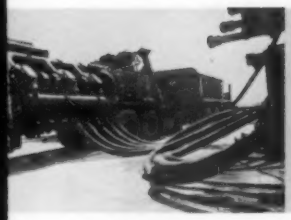
	Well No.	Perforating	Total Treatment Cost	Rig Time	Packer Rental	Misc. Cost	Total Cost
Conventional	1	$1,174.00	$14,984.00	$10,065.00	$4,056.00	$3,799.00	$34,078.00
	2	2,878.00	12,721.00	4,522.00	1,360.00	1,126.00	24,115.00
	3	2,564.00	11,134.00	2,633.00	1,930.00	2,547.00	20,808.00
Ball Sealers	4	2,447.00	9,025.00	500.00	0.00	850.00	13,469.00
	5	2,343.00	7,740.00	725.00	0.00	700.00	10,508.00
	6	1,246.00	5,035.00	500.00	0.00	750.00	7,531.00

Western Engineers can supply you with case histories for virtually any production area in the Southwest, showing both the economy and effectiveness of Ball Sealer controlled treatments.

To get the fullest advantages of Perforation Ball Sealer treatments, pinpoint the pay zones accurately with Western's Gammatron radioactivity logging. Instrumentation by Scintillation Counter, Ionization Chamber and Geiger Counter provides the finest detailed radioactivity logs available.

You can INTEGRATE your well completion or remedial program with Western's engineered well services—Gammatron logging, jet perforating, fracturing and acidizing—for greatest results.

For superior well services—GO WESTERN!



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WELL SERVICES

they can get permits to sell their gas to the interstate pipeline companies, and with their financing costs mounting meanwhile, are following suit. One small independent finder weighed the documents he was required to send to Washington for one proposed transaction, and the scale registered 30 lb."

Arthur Krock, in the New York Times.

Revised Oil-Demand Estimate

"Prior to the developments in the Suez, it had been anticipated that world petroleum-demand gains would continue at a moderate but healthy pace, probably in the neighborhood of 13 per cent for Europe, compared to 15 per cent in the first 10 months of 1956; and 6 per cent for the United States, as compared to 6½ per cent in the whole of 1956.

"But while the U. S. outlook remained essentially unchanged even after the Suez crisis, the likelihood of gains for Western Europe was wiped out. To the contrary, with severe rationing imminent in those countries, it is now anticipated that European demand will be off by 5-10 per cent (compared to the normal months of 1956) for a period of at least 6 months."

R. G. Follis, chairman of the board, Standard Oil Co. of California.

Monopoly Defined

"Monopoly must not be confused with bigness. Monopoly is merely the absence of competition. The owner of a $50 ferry barge in an area where there are neither other ferries nor bridges is more of a monopolist than General Motors, which controls half of America's gigantic automobile production.

"Public interest has nothing to do with the bigness of a corporation. Public interest is merely concerned with rigged prices, poor service and shoddy quality, which is the evil of the European style cartel."

Editorial in the Tulsa Tribune.

Fuel Oil Short on West Coast

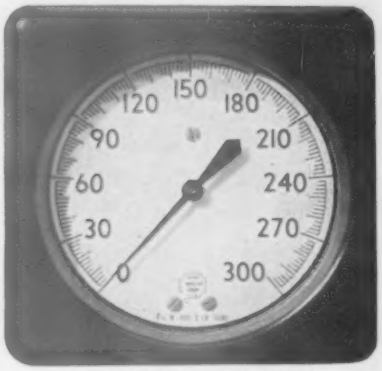
"A typical example of the deficiency of heavy fuel oil on the West Coast is the fact that in the last U. S. Government request for bids on this commodity the industry offers would meet only 50 per cent of District 5's military requirements for the first 6 months of 1957.

"The current price of fuel oil is not adequate to interest the refiner in switching his refinery runs from gasoline, which is in abundant supply, to fuel oil. We estimate it will require

ACCO products

Helicoid Gages

Long-life gages to meet every pressure indicating requirement



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a 20 to 30-cent increase per barrel in the fuel-oil price to make this possible.

"Present availability of both gasoline and mid-barrel products appears to be satisfactory, which would indicate no immediate price rises for these commodities. However, heavy fuel oil has not borne its proportionate share of recent increased costs of wages and materials, which accounts for the shortage of this commodity."

A. C. Rubel, president, Union Oil Co. of California, in a year-end statement.

CALENDAR OF EVENTS

JANUARY

14-16 Pipe Line Contractors Association, ninth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

14-18 Society of Automotive Engineers, annual meeting, Sheraton-Cadillac and Statler hotels, Detroit.

17-18 Engineers Joint Council, Statler Hotel, New York.

21-25 American Institute of Electrical Engineers, 1957 winter general meeting, Hotel Statler, New York City.

23-24 Northwest Petroleum Association, Nicollet Hotel, Minneapolis.

23-25 Instrumentation for the Process Industries, sponsored by Texas A. & M College, chemical engineering department, College Station, Tex.

25-26 American Association of Petroleum Landmen, directors meeting, Hilton Hotel, San Antonio, Tex.

31-Feb. 1 Annual instrument short course of Southern California Meter Association, Los Angeles Harbor Junior College, Wilmington, Calif.

FEBRUARY

4-8 American Society for Testing Materials, annual committee week and spring meeting, Benjamin Franklin Hotel, Philadelphia.

6 Petroleum Equipment Suppliers Association, Pacific district spring meeting, Ambassador Hotel, Los Angeles.

7-8 Western Petroleum Refiners Association, Gulf Coast regional technical-industrial relations meeting, Lamar Hotel, Houston.

8-9 American Society for Testing Materials, Symposium on composition of petroleum, Jung Hotel, New Orleans.

13-15 National Association of Corrosion Engineers, Tulsa section, eighth annual short course for pipeliners, Hotel Mayo, Tulsa.

15-16 National Society of Professional Engineers, spring meeting, Hotel Francis Marion, Charleston, S. C.

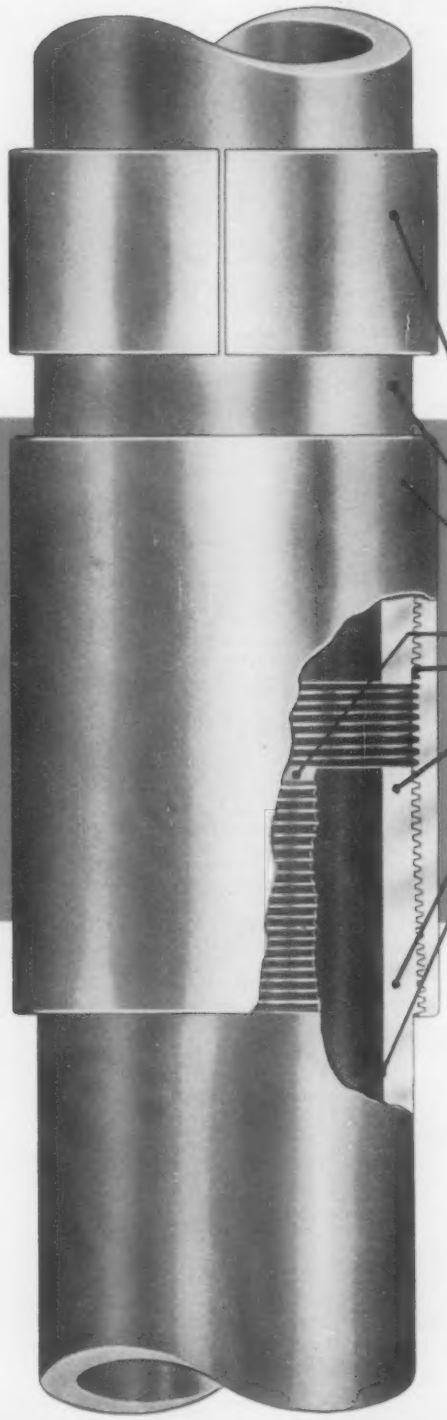
18-19 Association of Oilwell Servicing Contractors, first annual meeting, Hotel Texas, Fort Worth.

21-22 Chemical Institute of Canada, eleventh division conference, protective coatings division, Seaway Hotel, Toronto, February 21, and Ritz Carlton Hotel, Montreal, February 22.

22 Natural Gasoline Association of America, Permian basin regional meeting, Scharbauer Hotel, Midland, Tex.

Fibercast

LINE PIPE and WELL TUBING



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8. Smooth interior with a Hazen-Williams C Factor-147

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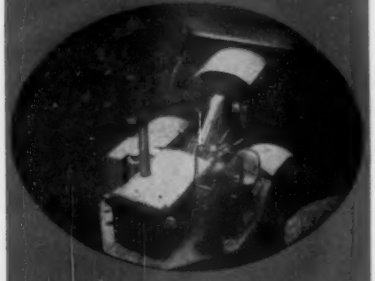

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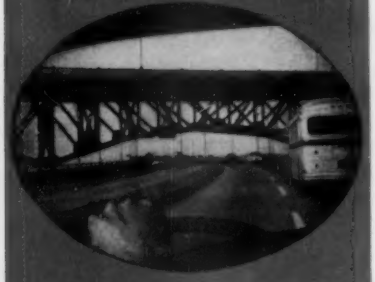
detergent-inhibitor additives



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Pioneer in Petrochemicals

24-28 American Institute of Mining, Metallurgical and Petroleum Engineers, annual meeting, Hotels Roosevelt and Jung, New Orleans.

25-27 American Association of Petroleum Geologists, Rocky Mountain section, Rainbow Randevu, Salt Lake City.

27-28 Gas Conditioning Institute, sponsored by the University of Kansas extension, Southwest Kansas Center, Randall's, Liberal, Kans.

MARCH

3-6 American Institute of Chemical Engineers, regional meeting, the Greenbrier, White Sulphur Springs, W. Va.

6-8 American Petroleum Institute, Southwestern district production division meeting, Statler-Hilton Hotel, Dallas.

8 Ohio Oil and Gas Association, winter meeting, Deshler-Hilton Hotel, Columbus, Ohio.

11-15 American Institute of Chemical Engineers, regional meeting, Philadelphia.

11-15 National Association of Corrosion Engineers, Kiel Auditorium, St. Louis.

11-21 Quality Control by Statistical Methods, tenth annual short course, sponsored by University of Illinois, College of Engineering and Division of Engineering Extension, Champaign, Ill.

12-13 Subsurface Geology Symposium, fifth annual conference, sponsored by the University of Oklahoma, Norman, Okla.

13-15 Society of Exploration Geophysicists, tenth annual mid-western meeting, Hotel Texas, Fort Worth.

20-22 American Petroleum Institute, southern district production division meeting, Washington-Youree and Captain Shreve Hotels, Shreveport, La.

25-27 Western Petroleum Refiners Association, annual meeting, Hilton Plaza Hotel, San Antonio, Tex.

27-29 American Power Conference, Sherman Hotel, Chicago.

APRIL

1-4 American Association of Petroleum Geologists, national convention, Kiel Auditorium, St. Louis.

2-4 Corrosion Control, fourth annual conference, sponsored by National Association of Corrosion Engineers and the University of Oklahoma College of Engineering, University of Oklahoma, Norman, Okla.

7-10 Petroleum Equipment Suppliers Association, annual convention, Palm Springs, Calif.

7-12 American Chemical Society, national meeting, Miami, Fla.

8-10 American Society of Mechanical Engineers, spring meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.

9-11 American Welding Society, fifth annual welding show, Convention Hall, Philadelphia.

10-12 American Petroleum Institute, Mid-Continent district production division meeting, Mayo Hotel, Tulsa.

11-13 Institute of Radio Engineers, ninth annual southwestern I.R.E. conference and electronics show, sponsored by Houston section, Shamrock Hilton, Houston.

11-13 Institute of Radio Engineers, second national simulation conference, sponsored by Professional Group on Electronic Computers, Shamrock Hilton Hotel, Houston.

11-13 American Institute of Mining, Metallurgical, and Petroleum Engineers, Pacific Northwest Regional Conference, Portland, Ore.

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With investment and labor costs continuing to increase, economy of operation is of paramount importance in producing wells with decreasing oil-water ratios.

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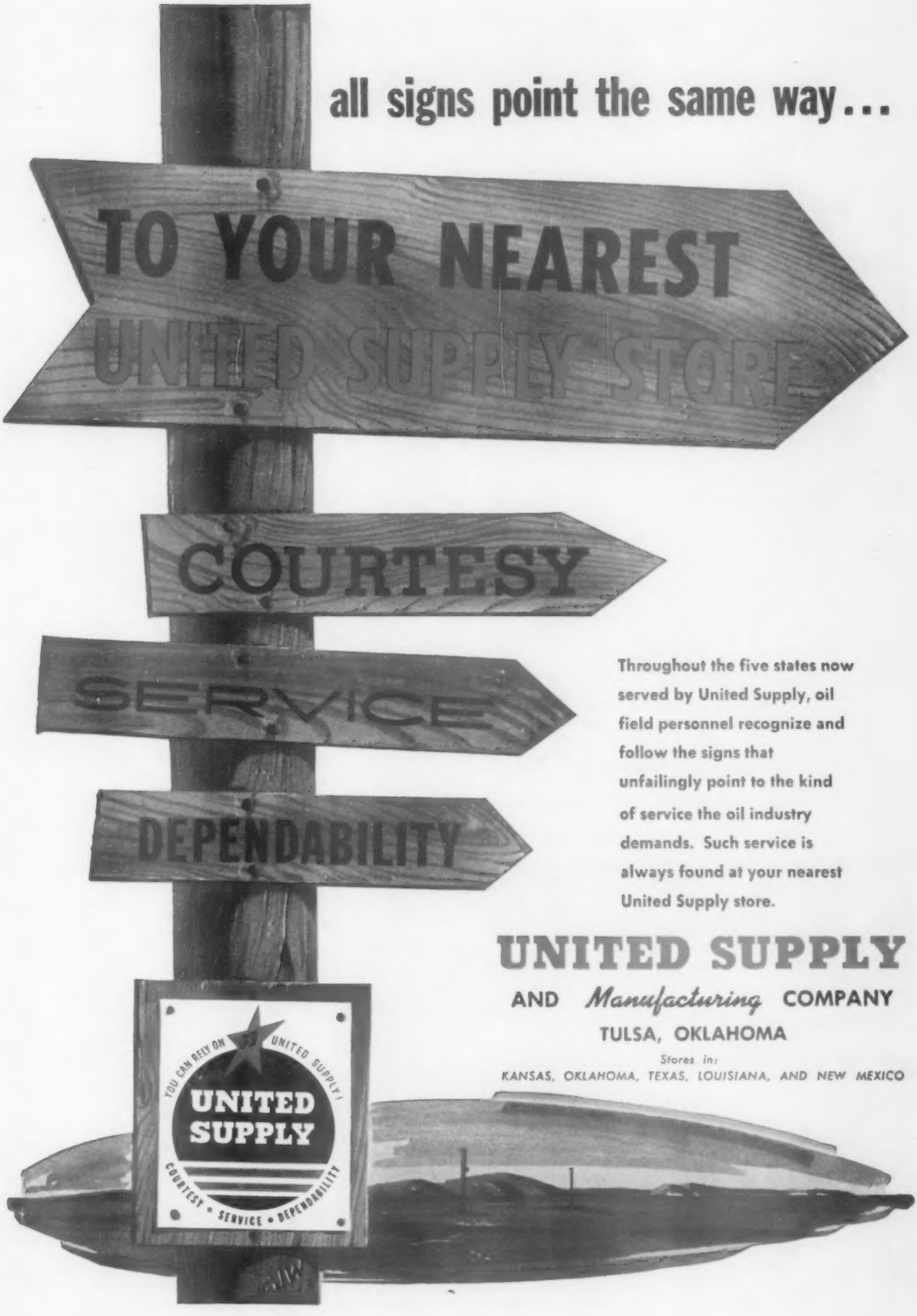

Throughout the five states now served by United Supply, oil field personnel recognize and follow the signs that unfailingly point to the kind of service the oil industry demands. Such service is always found at your nearest United Supply store.

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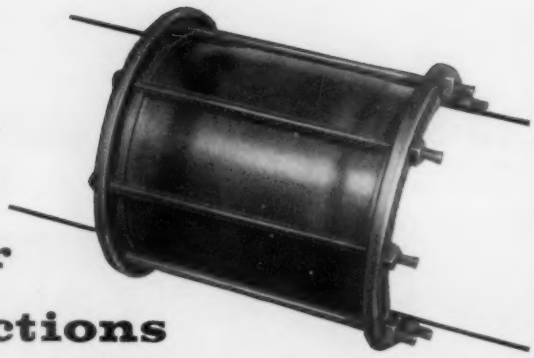

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You'll find many piping jobs in and around oil terminals and refineries that can be simplified and speeded up with Dresser Couplings and Long Sleeves.

Particularly advantageous for tank and equipment installations, Dresser Couplings have a special "built-in" give and take that absorbs vibration, settlement and other stresses.

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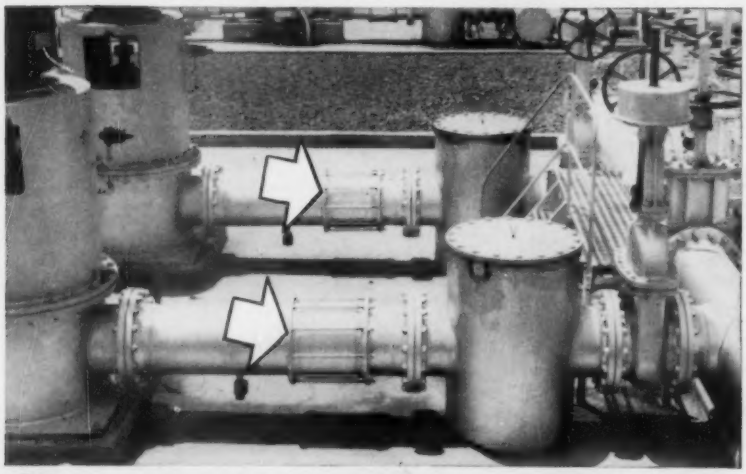
Dresser 10" Style 40 Long Sleeves on pump at oil terminal



Style 38 Coupling

Style 40 Long Sleeve

Hydrepair® Asbestos Cement Pipe Clamp

Style 63 Expansion Joint

Style 39 Insulating Coupling

16-18 Petroleum Industry Electrical Association, annual meeting, Shamrock Hotel, Houston.

16-18 Petroleum Electric Suppliers Association, Shamrock Hotel, Houston.

16-18 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla.

16-18 National Petroleum Association, fifty-fourth semiannual meeting, Cleveland.

24-26 National Gasoline Association of America, thirty-sixth annual convention, Rice Hotel, Houston.

24-26 American Petroleum Institute, Rocky Mountain district production division meeting, Gladstone, Townsend, and Henning Hotels, Casper, Wyo.

25-27 American Association of Petroleum Landmen, third annual convention, Hilton Hotel, San Antonio, Tex.

28-30 Independent Petroleum Association of America, midyear meeting, Buena Vista Hotel, Biloxi, Miss.

29-30 Automatic Control in the Petroleum and Chemical Industries, conference sponsored by the University of Oklahoma, extension study center, University of Oklahoma, Norman, Okla.

29-May 1 Southern Gas Association, annual convention, New Orleans.

MAY

6-8 American Petroleum Institute, annual pipeline conference, Cleveland Hotel, Cleveland.

6-8 American Geophysical Union, thirty-eighth annual meeting, National Academy of Sciences, Washington, D. C.

7 American Gas Association, committee on underground storage, operating section, Mark Hopkins Hotel, San Francisco.

8-10 American Gas Association, Pacific Coast Gas Association, gas supply, transmission, and storage conference, Mark Hopkins Hotel, San Francisco.

12-15 Liquefied Petroleum Gas Association, annual meeting, Conrad Hilton Hotel, Chicago.

13-15 Industrial Waste Conference, sponsored by Purdue University, Purdue Memorial Union Building, Lafayette, Ind.

13-16 American Petroleum Institute, division of refining, midyear meeting, Sheraton Hotel, Philadelphia.

14-16 Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and Nucleonics Magazine, Museum of Science and Industry, Chicago.

19-22 Texas Independent Producers and Royalty Owners Association, Galvez and Buccaneer Hotel, Galveston, Tex.

20-22 American Gas Association, chemical, engineering, and manufactured gas production conference, Balmoral Hotel, Bal Harbour, Fla.

20-23 American Society of Mechanical Engineers, twenty-ninth annual conference and exhibit of the oil and gas power division, Kentucky Hotel, Louisville, Ky.

21-23 Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa.

22-24 American Petroleum Institute, division of production, Eastern district meeting, William Penn Hotel, Pittsburgh.

23-24 Kentucky Oil and Gas Association, annual membership meeting, Hotel Phoenix, Lexington, Ky.

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ONLY HOMCO MAKES KLUSTRITE®

When Klustrite is specified, look for the HOMCO symbol.

HOMCO Klustrite Rotary Shoes have performed outstandingly in the field of washover cutting operations*.

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Cutting and Burning Rotary Shoes
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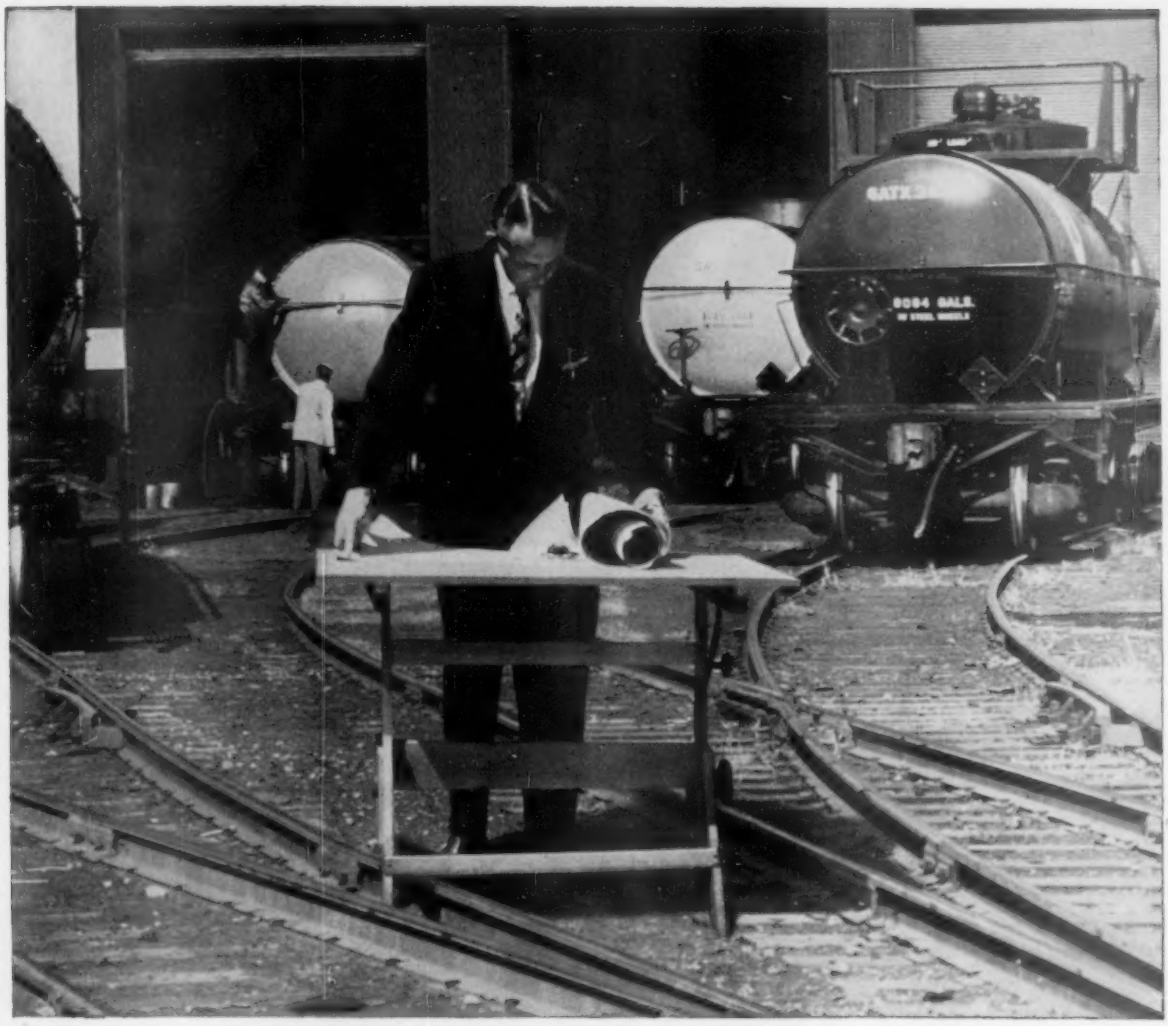

What does an engineer do for GATX?

Engineering a special-purpose tank car is a job for experts. Stress, mobility, center of gravity, corrosion resistance—these are a few of the factors to be considered. At General American you'll find engineering specialists—men who pioneered with aluminum tank cars. These made possible bulk shipments of hard-to-handle liquids. You'll find men who developed the first flued-dome tank car, the first all-welded underframes, the first half-oval heater coils—and a long list of additional improvements.

This engineering skill and experience that make such developments possible is part of every GATX lease—a lease that provides shippers with the most dependable service available for bulk liquid transportation. When you lease cars from General American, you avoid the need for capital investment as well as operating, servicing and maintenance problems.

If you'd like additional information concerning the advantages of a GATX lease, call or write your nearby General American District Office.

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GENERAL AMERICAN TRANSPORTATION CORPORATION

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Service Offices In Principal Cities
Service Plants Throughout The Country

The OIL AND GAS JOURNAL

TULSA, OKLAHOMA

Published every Monday by The Petroleum Publishing Co., 211 South Cheyenne Avenue, Tulsa, Okla. Phone Diamond 3-6291. Founded in 1902. Name changed to The Oil and Gas Journal in 1910 by Patrick C. Boyle.

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JOURNALLY SPEAKING . . .

Fractured Phonetics

THE fact that this issue carries a special section on fracturing gives us a long-awaited opportunity to lash out at the oil industry for one of its more serious crimes.

Not that we have anything against fracturing an oil-bearing formation. What causes us to writhe in anguish is fracturing the King's English.

We refer to the, er, the word—the so-called word, the illegitimate, deformed, monstrosity of a word—contracted from the perfectly good verb "fracture" and written "fracing" in the participle form and "fraced" in the past tense.

There just ain't no such word. If there were, by all the rules it would have to be pronounced with a soft "c" having the sibilant sound of "s."

If the two-syllable word "fracture" is too long and difficult for oil men to pronounce, a contraction to "frac" perhaps may be tolerated as a slang or colloquial expression. But if the oil industry insists on adding "ing" or "ed" to this truncated verb it ought to have the grace to follow the established rules of English philology, phonology, and morphology.

These rules say that when a suffix beginning with a vowel is added to a word ending in a hard "c," the "c" must be followed by a "k" in order to preserve the pronunciation. Common examples are "picnicking," "frolicking," "trafficking," and "panicking."

We are not the only champion of linguistic purity whose inner sensibilities have been outraged by this case of the missing "k."

We have a copy of a letter which a petroleum engineer, no less, wrote to an oil-well service company complaining about the use of "fracing" in its advertising. The advertising manager of that company replied, and we quote:

"We spell 'picnicking' and 'frolicking' exactly the way you do. Both 'picnic' and 'frolic,' however, have an ending quite different from the word 'fracture.' Our advertising agency has spent considerable time with this word 'fracture.' They have found that the word 'frac' is the accepted oil-field abbrevitaion for the word 'fracture,' and 'fracing' is used as a short form of 'fracturing.'

"When preparing copy for TV or radio the word is spelled as you suggest (fracking) for phonetic correctness, but when making an appeal to people who use the word 'frac' as a helpful short cut in everyday conversation, 'fracing' is used."

We say phooey to this advertising agency and its so-called research into oil-industry jargon. Since when did the oil industry become a recognized authority on etymology, orthography, and literary usage? Just because the oil industry is smart enough and progressive enough to know how to fracture formations doesn't give it license to fracture phonetics.

The oil industry has just got to learn that there are limits to free enterprise and individual liberty. If it's going to live in civilized society it's got to abide by the rules thereof. And one of these rules is that a combination of letters arranged like "fraced" is pronounced "frased."

If the industry wants to invent a word that rhymes with "cracked" it's got to spell it the same way. How would a normal person outside the oil business, familiar with words like "faced," "paced," "raced," and "braced," pronounce "fraced"? That advertising manager gave the answer himself when he admitted that for TV and radio announcers (who probably aren't much dumber than other people outside the oil and advertising industries) he has to write "fracked" and "fracking."

If the language experts in the advertising agencies are correct in finding that the oil industry insists on this unspeakable spelling, then we must conclude that the oil industry is determined to keep itself as mysterious and misunderstood as possible by torturing a perfectly good and simple word like "fracture" into a form completely unrecognizable to anyone not in the inner circle.

Sometimes we brag: "Follow the Journal and you follow the oil industry." But the Journal is not going to follow the oil industry into such weird distortions of our mother tongue.

For proof, read the special section starting on page 91. It tells all about well fracturing without once resorting to the use of the linguistic abortions "fracing" and "fraced." Bet you don't feel the lack of them, either.

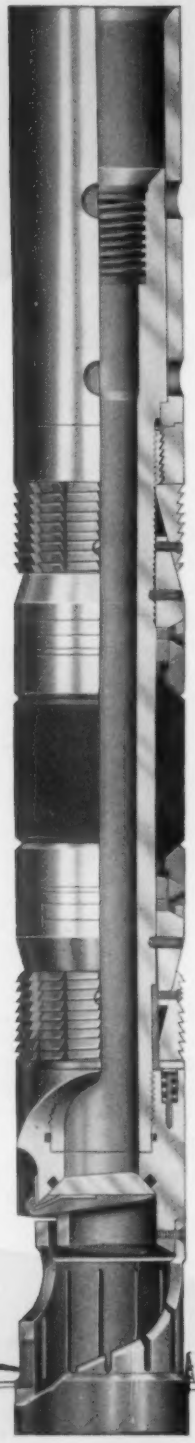
—*Henry D. Ralph.*

For Permanent-Type Well Completions

THE BAKER

RETAINER PRODUCTION PACKER

PRODUCT NO. 415D



BAKER PACKERS ADD PERMANENCE TO PERMANENT-TYPE WELL COMPLETIONS

When you select a Packer for a Permanent-Type Well Completion, remember this fact: of all the tools used in permanent-type well completions, only the *Packer* is required to be *permanent*. Guns, Extensions, Plugs, Gas-Lift and Circulating Valves can be removed or replaced on wire line . . . but the Packer, like the casing, is required to perform for the life of the selected producing intervals. Baker Packer Completions are Permanent Completions from the standpoint of packer performance.

Advantages of Baker Retainer Production Packer in Permanent-Type Well Completions:

PERMANENT, RELIABLE PACK-OFF will hold against any pressure differential from above or below that is safe for the casing.

FREE TUBING STRING . . . neither set-down tubing weight nor tubing tension required to achieve and maintain pack-off. Tubing can be anchored to Packer if desired.

CAN BE USED AS A SQUEEZE OR A PRODUCTION TOOL.

MEETS PERMANENT-TYPE WELL COMPLETION DIMENSIONAL REQUIREMENTS.

CAN BE SET ON WIRE LINE. PERMITS EASY REMOVAL OF TUBING STRING.

READILY DRILLABLE IN CASE OF EMERGENCY OR NEED.

BAKER OIL TOOLS, INC. HOUSTON • LOS ANGELES • NEW YORK

What determines the price of crude oil?

ANY suspicion that the price of crude oil is artificially rigged or arbitrarily set up by an alleged monopoly or conspiracy of big oil companies should be easily dispelled by a study of the price behavior during the past 10 days.

The price increase was initiated by Humble Oil & Refining Co., which currently is acting as the biggest single procurement agency in this country for large European refineries. There is ample evidence on the public record that Humble could not obtain all the crude it needed. It couldn't even buy crude held in storage by others.

Humble had sound reasons for believing that a higher price would bring out more supplies. It posted increases throughout its territory, including 35 cents per barrel in North Texas. This was a cue for some other buyers to go up 35 cents in the Mid-Continent.

BUT THIS DIDN'T STICK. Some other big buyers, not so much involved in supplying Europe's emergency needs, went up only 25 cents. Therefore those who acted early had to come back down a dime to meet the competition.

So, after a hectic week of testing the market, it appears that the initial increase was too high in the judgment of the majority of the nation's refiners. The confusion and hesitation among crude purchasers, and the way in which they were all caught by surprise, is clear proof that there was no collusion or concerted action.

Factors of supply and demand caused the upward movement—and also the retreat from the initial peak of the increase. Individual purchasers named prices they are willing to pay in particular areas on the basis of their own needs and the competitive situation generally.

If producers had had any say in the matter, the price increase would have been greater—well justified by mounting costs. Since the last increase in 1953, for example, oil wages have gone up 34 cents per hour and the price of steel pipe has risen 35 per cent.

In spite of all this, the air is filled with irresponsible charges of "robbery" of consumers by "oil-rich millionaires." There will probably be a congressional investigation of the crude-price increase, but if the real facts are brought out it should die a-borning.

THE AGONY INVOLVED in "this lousy two bits" increase, when prices of everything else go up without a murmur, points up the industry's future problem of getting and holding a crude-price level that will cover replacement costs and develop new reserves.

The industry can't live with the excess producing capacity it is asked to carry as a defense reserve unless both the economic and political factors which influence prices will permit a price structure which justifies the costs and risks of the business.

Now... 6 to 10 Months Delivery

on LETOURNEAU mobile offshore platforms

LeTourneau Offshore Platforms, which can make location changes within hours instead of days, are now available in "turn-key" condition within 6 to 10 months — depending upon design selected — on a *first-come-first-served-basis.*

Platforms can be obtained in several types, for workover and completion, as well as for deep drilling. All are modern tripod construction . . . highly mobile and rapidly self-elevating . . . fabricated with matched and proven components manufactured by R. G. LeTourneau, Inc.

The first LeTourneau Platform, christened the "Scorpion" by its purchaser Zapata Offshore Company, has proved outstanding in its ability to make fast location changes, as well as in overall performance. Its success has resulted in an order by Zapata for a second platform now under construction for delivery early in 1957.

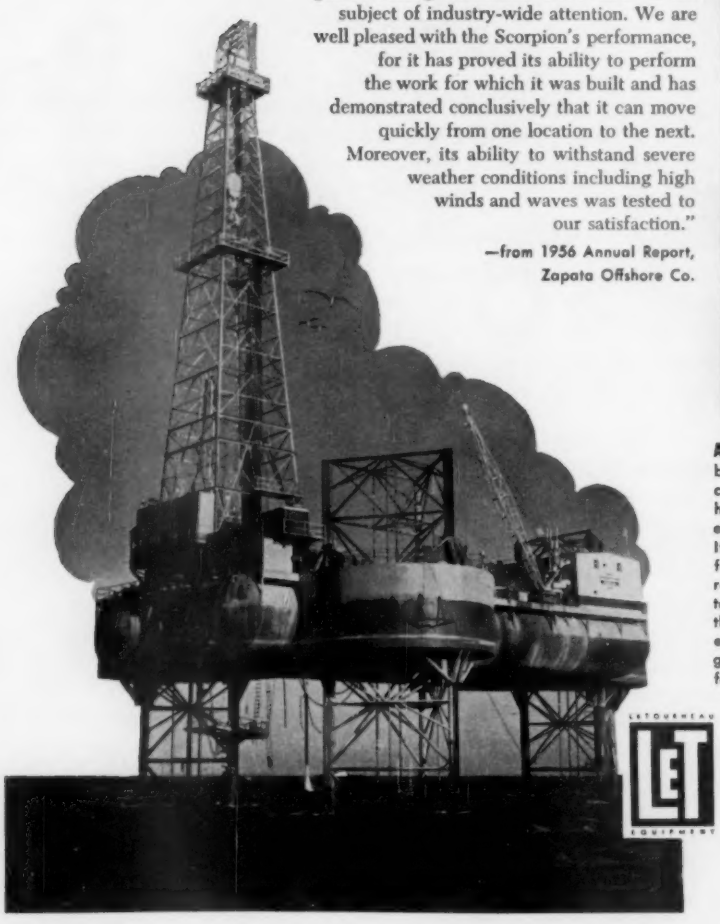
The "Scorpion", which spudded in its first well March 25, 1956, has performed successfully under a wide range of operating conditions.

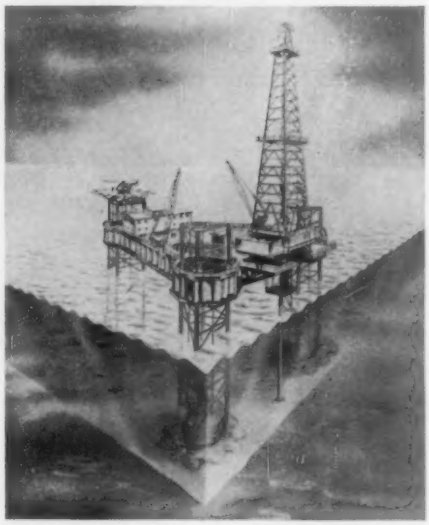
A drilling platform to meet your specific operating conditions can now be provided through the combination of LeTourneau creative engineering and the LeTourneau system of power and control. Let our engineers discuss with you your offshore drilling problems, without obligation. A LeTourneau Mobile Platform can be built to fit your needs — all inquiries confidential, of course. Write or call us today.

PERFORMANCE REPORT

"The Scorpion's unusual 3-legged design and its unique electrically driven rack-and-pinion raising mechanism have made it the subject of industry-wide attention. We are well pleased with the Scorpion's performance, for it has proved its ability to perform the work for which it was built and has demonstrated conclusively that it can move quickly from one location to the next. Moreover, its ability to withstand severe weather conditions including high winds and waves was tested to our satisfaction."

—from 1956 Annual Report, Zapata Offshore Co.





ARTIST'S CONCEPT of Zapata Platform No. 2 now being built at LeTourneau's Vicksburg, Miss., plant. This self-contained unit will carry its own cranes, mooring winches, heliport, electric logging unit, bulk mud and cementing equipment and complete heavy-duty drilling equipment. It is capable of drilling to a depth of more than 20,000 feet and can operate in 100 feet of water. With the spuds retracted, the unit becomes a floating barge that is towed to location and self-elevated to the desired height above the water. The three legs are lowered and raised by electric gearmotors driven by a powerful diesel-electric generating plant. It can be elevated at the rate of one foot per minute.

LET EQUIPMENT

R.G. LETOURNEAU INC

MARINE PRODUCTS DIVISION

2861 South MacArthur Longview, Texas

M-104

The Industry This Week

• **INDUSTRY:** Crude prices rose from the gulf to the Rockies last week. But the most interesting aspect of company actions was the fact that they were much different from the pattern of recent years. P. 64.

Ships bottled in the Suez Canal have moved out, and salvage activity is being stepped up. But Nasser threatens to bar British and French shipping when canal is cleared. Syria also is holding up repairs on damaged I.P.C. pipelines. P. 88.

• **REFINING:** First two Gulfining units using the new process for making high-quality heating oils have gone on stream at Gulf's Port Arthur refinery. P. 79.

Standard of Ohio has let contract to M. W. Kellogg for its new 60,000-bbl. Toledo plant. P. 82.

• **EXPLORATION:** Alaska's highly regarded Kenai Peninsula will get its first wildcat in March. Richfield plans the test for a 71,680-acre unitized area in the national moose range. P. 84.

Most prolific Heath discovery in Williston basin history is indicated at Northern Pump 1 Fritz in Billings County, North Dakota. Flow was at rate of 1,200 bbl. daily. P. 84.

Mississippi may have another major field 20 miles northwest of the prolific Soso field. California Co.'s discovery well is on the same Lower Cretaceous trend running southeastward through Soso and Citronelle in Alabama. P. 67.

• **PRODUCTION:** Operators may be able to cut their logging costs with a new package-type well-survey tool. It obtains with one run into the hole the data which formerly required two and sometimes three runs. P. 82.

The Netherlands is stepping up its domestic crude production 15 per cent in the first quarter to help ease effects of Middle East pinch. P. 90.

• **PIPELINING:** Big Chicago products market will have another competitor by summer. Buckeye Pipe Line is converting an 8-in. crude line from Huntington to Griffith, Ind., to products service. It gives Toledo refiners an outlet to Chicago. P. 76.

More Alberta gas is coming south into the U. S. Westcoast Transmission is planning a $100 million expansion to double export capacity and provide first outlet for Savanna Creek gas. P. 66.

Foreign pipeliners also are busy. Final work will start soon on NATO products line in Turkey. First test shipment has entered the new military products line in Spain. P. 89 . . . Work started last week on Shell's 177-mile Venezuelan line, and bids are being taken on Argentina's $119 million crude and gas-pipeline construction program. P. 87.

Four pipeline firms are linking parts of their systems to ship products from Philadelphia to Pittsburgh. P. 84.

How Oil Buyers Raised Crude Prices*

Company—	Gulf Coast	East Texas	W. Tex.-N. M.	N. Texas	W. Cent. Texas	Okla.	Kans.	Ill.	S. La.	N. La.	Ark.	Ky., Ohio	Rockies
Anderson-Prichard	..	..	..	..	..	25	25	..	..	..	..	..	..
Ashland	..	..	..	..	..	..	..	25	..	..	..	..	..
Carter	40	35	25	25	..	25	25	25	40	..	..	..	25
Cities Service	..	35	25	25	25	25	25	..	40	..	..	..	..
Continental	40	..	35	..	..	35	35	..	40	..	..	..	17-35
D-X Sunray	..	..	..	..	..	25	..	..	..	..	..	..	..
Esso Standard	..	..	..	..	..	..	..	..	40	25 to 35	..	..	..
Gulf	30-55	35	30	30	30	25	..	..	40	..	..	..	..
Humble	40-45	35	25	..	..	..	..	..	..	..	..	..	..
Magnolia	45	35	25	25	25	25	..	35	40	..	..	..	..
Ohio	..	35	25	..	..	..	..	..	..	..	30	..	25
Phillips	..	35	19-25	25	25	25	25	..	..	..	..	..	..
Rock Island	..	..	..	..	..	25	..	..	..	..	..	..	..
Shamrock	..	..	29	..	..	..	..	..	..	..	..	..	..
Sinclair	35-40	35	25	25	25	25	25	..	..	..	..	..	23-25
Stanolind	32-45	..	25	25	25	25	25	..	40	..	30	..	25
Sun	40	35	25	25	25	..	..	..	40	..	..	..	..
Sohio	..	35	25	25	..	25	25	25	..	..	..	25	..
Southern Minerals	35	..	..	..	..	..	..	..	..	..	..	..	..
Shell	30-35	35	25	25	25	25	25	35	40	..	..	..	..
Texas Co.	40	25-35	35	..	..	35	35	35	40	..	..	..	..

*Still in effect noon, January 10.

What's Behind the Oil-Price Confusion?

CRITICS of the oil industry who think crude prices are rigged must have been confused last week. But so were the oil buyers. They busily posted increases, then shifted them. For rules in the oil-pricing game were changing.

Patterns followed in past periods when oil prices jumped were tossed overboard. The result: Complete confusion in many areas until late in the week. Then competition forced quick readjustment to common values.

Out of the welter of announcements and substitute postings, this much was clear:

... **Traditional leaders** were not followed down the line. In some areas the price quoted by the first company out with an increase was chopped down by smaller hikes of those who moved later. In the postwar era prices quoted by the leader usually have been met by competitors—if met at all.

... **Prices differed** across the country. Some areas get much larger increases than others. A few even got a cut in the shuffle. Gone were the across-the-board increases for all areas where a company buys.

... **Effective dates** for the increases also suffered. In the past increases usually have been effective on the date the leader first posted the hike. Some companies made their increases effective as of January 3, some January 7, and others January 9. A few days' difference can mean a big loss or gain both for the producers and buyers.

These differences resulted from tendency of oil-company officials to move slowly and take a long look at their individual positions before posting new schedules.

... **Product prices** also went up in some areas. But it's doubtful the increases on gasoline will stay up because of excessive stocks. Often in the past product prices have followed crude prices upward.

What's the picture? . . . These are the trends for increases announced by more than a score of companies (see table):

... **Gulf Coast** and southern Louisiana fields—35 to 55 cents a barrel. The average hit about 40 cents. Higher prices went to special crudes with a peculiar refining value.

... **East Texas**—35 cents.

... **Other Texas** fields including West Texas, North Texas, West Central Texas, and New Mexico—25-35 cents. But this likely will be readjusted to the 25-cent level throughout the area.

... **Oklahoma and Kansas**—initially 35 cents but later postings were moving this to 25 cents. Two changes for a few counties in north-central Kansas actually resulted in a price cut for grades below 24° gravity. This came when a 4-cent differential was applied below 36° gravity.

... **Illinois**—25 to 35 cents and Kentucky, Ohio, and Indiana—25 cents.

... **Arkansas**—30 cents and northern Louisiana 25.

... **Rocky Mountains** plus North Dakota 25-35 cents. In some instances it was more where flat-price quotations were discontinued and certain fields put on schedules.

Unaffected areas were the West Coast and Pennsylvania Grade fields, although West Coast firms reportedly were studying the price structure there too. Also none of the moves by American companies involved their price postings in Canada. But many Canadian contracts call for prices based on Wood River and Wyoming quotations. With the American base for these prices moved up, prices on Canadian oil are expected to increase soon.

Why the confusion? . . . Explanations for the variety of postings were nearly as confusing as the postings themselves. But factors involved were:

... **Export demand.** The Gulf Coast and southern Louisiana fields easily accessible to tidewater got the premium increases. Their oil can be shipped to Europe more quickly and at less cost for use in the temporary shortage caused by the Middle East blockade.

... **Refining values** of different crudes. Some company officials said privately they tried to make the price increases reflect the value of different crudes for their refining operations. Since the value of the same crude even will vary from plant to plant depending on its equipment and transportation costs, this may partially explain the wide spread among the increases.

... **Competition.** Other companies reported some of their former prices were a few cents out of line with competing buyers. Some odd increases thus lined up competing prices.

... **Peculiar positions** of individual companies. Those with oil-producing capacity exceeding refining needs would profit by higher prices for crude. Others whose refining requirements exceeded production could be pinched. They would have to recover the added cost of their raw material through higher product prices.

This explains the immediate move by several companies to increase tank-wagon prices of products by 1 cent a gallon. But the pattern was far from set, and no one knew whether they will stick.

The distressing facts about products are these: Stocks of the four products are up 51,332,000 bbl. compared with this time last year. Individual stocks are: Gasoline up 17,798,000 bbl., kerosine up 4,849,000 bbl., distillate up 25,673,000 bbl., and residual up 3,012,000 bbl.

They give little cheer to hopes among refiners that product-price increases will take hold.

... **Fear of reaction.** A few company officials privately expressed fear the domestic industry will face trouble when the Suez Canal is reopened and the Syrian pipeline mended. They preferred to go easy on increasing prices and kicking up production now.

The outlook ... The almost unanimous feeling in the industry is that higher prices for crude are easily justified. Cost of materials and services in the industry have skyrocketed since the last general price increase 3 years ago. Increases of 50 to 75 cents a barrel could be justified on that basis.

But excess producing capacity of the domestic industry made those price goals unrealistic. The differences of opinion on how much to raise and still be in line with demand when Middle East oil returns to the market helped create the confused pricing.

The reaction . . . Complaints outside the oil industry, railing at the higher prices, came quickly. They were heard in:

... **Washington** where Congress got demands for an investigation and for suspension of the Connally Hot Oil Act.

... **London** where the British press teed off on "Texas oil jillionaires." This brought a sharp retort from five Texas oil associations defending the new prices.

Marketers ask probe . . . Independent marketers moved to force either the administration or Congress to investigate the crude and gasoline price increases.

The National Oil Marketers Association, in a letter to President Eisenhower, charged that Texas and other states, by deliberately holding back production, paved the way for higher crude prices.

The N.O.M.A. has a remedy for the situation. It urged Eisenhower to suspend the Connally Hot Oil Act, which prohibits shipment from any state of oil produced in excess of allowables.

The Connally Act itself provides for such suspension. But it must be found that production is being kept below market demand, "resulting in an undue burden on or restriction of interstate commerce" in oil.

"Even a casual investigation will disclose that Texas and other oil-producing states are deliberately holding back the production of crude oil much below the demand for domestic and export," Paul E. Hadlick, counsel of N.O.M.A., charged.

The last investigation of the industry's prices was in 1953, following a 25-cent increase on crude. The only results were the writing of some anti-monopoly bills which never were passed.

Industry circles are confident that the current upward trend can be justified by increased costs, particularly in labor and steel, since 1953.

Effect on Congress . . . A new probe now, however, could have an adverse effect on congressional sentiment on other oil matters which are expected to come up this year.

It could have influence on the effort to relieve independent gas producers from federal regulation. And it could intensify the attack on the industry's depletion allowance.

More directly, the price increases are expected to be reflected in a bid by the Justice Department for more money for its continuing study of operations under the Interstate Oil Compact. How much the department will ask will be discussed in the annual budget which will go to Congress this week.

The department last year asked for $750,000 for the all-out investigation which Atty. Gen. Herbert Brownell, Jr., said would be necessary to show whether the compact was curbing free competition. Congress didn't believe such an extensive inquiry was needed and cut the fund to $25,000.

In his first report on the compact, last September, Brownell failed to say whether activities of the compact states violated the antitrust laws. But he quickly pointed out that this report was merely "a starting point" for further inquiry *(The Oil and Gas Journal, September 10, 1956, page 88).*

British angry . . . Newspapers in London took the oil-price increase as an occasion to blast Texas oil leaders.

The Daily Sketch headlined: "Texans hint at ransom price." It printed a cartoon showing British industry as a stagecoach being held up by a mounted horseman labeled "Texas Oil." In an article the tabloid declared "Texas oil bosses" have hinted at the terms under which they will increase production to ease Britain's petrol crisis.

The Daily Express said that in Britain, Texas means "the place where oil men already wealthy are trying to squeeze still higher the dollar price we have to pay for their product."

The more temperate financial editor of Reuters, however, gave his readers a different picture. He pointed out the hardship on British industry and consumers that the price increases impose but said the price hikes were "not unreasonable or unbusinesslike."

Texans reply . . . Representatives of five Texas oil associations meeting in Fort Worth last week answered the British. In a lengthy statement they claimed:

... **Products shipments** have been resisted by governments of some European countries and some large foreign companies.

... **Official estimates** of oil requirements from Western Hemisphere to fill Middle East deficit have been fully met.

... **Texas independents** at no time sought to deny oil for whatever true market demand existed here and abroad.

... **Crude price increases** are long overdue on basis of production costs alone and are in no sense unfair to consumers here or abroad.

The independents contended that regardless of supplies available European governments have tried to restrict use of dollar-oil by rationing, higher duties, and increased prices. This was a dollar-conserving move but citizens were allowed to believe it was because the U. S. was denying them oil.

More Gas Heads South

Westcoast Transmission outlines $100-million expansion that will double exports to U. S., tap Savanna Creek gas

CALGARY. — A $100,000,000 natural-gas pipeline expansion program by Westcoast Transmission Co., Ltd., will provide another important outlet for Alberta gas and will double exports of Canadian gas to the United States.

The program will include:

. . . Construction of a 174-mile, 30-in. gas line to the Canadian-Idaho border, providing the first outlet for natural gas from the Savanna Creek pool 60 miles southwest of here (see map).

. . . Increasing capacity of the main line which is under construction from the Peace River area of northern Alberta and British Columbia to the Pacific Northwest.

Westcoast Transmission will spend $55,000,000 to add compressor stations and other facilities to boost capacity from the presently planned 400,000,000 cu. ft. daily to 660,000,000 cu. ft.

Westcoast began building the 650-mile Peace River line last spring. It is now 70 per cent complete, with operations expected to begin next fall.

. . . Construction of a 500-ton sulfur plant in the Savanna Creek area. This project, together with the proposed 174-mile gas line, would cost an estimated $45,000,000.

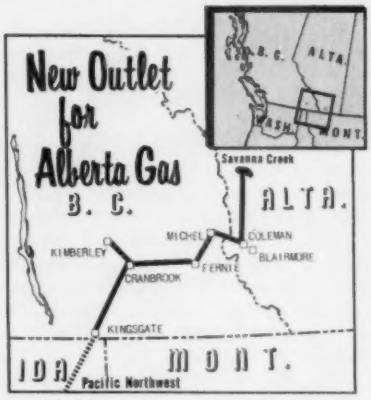
In connection with the expansion program, Westcoast has made new contracts with:

. . . Phillips Petroleum Co. for purchase of as much as 125,000,000 cu. ft. of gas daily from the Savanna Creek pool. Phillips is operator and 27½ per cent owner of the 78,000-acre Savanna Creek block. Phillips also will supply Westcoast up to 187,500,000 cu. ft. daily from its Peace River reserves.

. . . Pacific Northwest Pipeline Corp. for sale of an additional 350,000,000 cu. ft. of gas per day. This is an addition to 300,000,000 cu. ft. which Westcoast will supply Pacific Northwest starting late this year as result of a 1954 contract. Pacific Northwest plans to spend approximately $80 million laying new lines and adding compressor horsepower to gain the additional capacity.

The Savanna project . . . The Phillips contract calls for wellhead prices escalating progressively from 10¼ cents to 19 cents per thousand cubic feet, plus an additional cent when the new line attains sales volume of 250,000,000 cu. ft. daily.

Phillips officials said the contract "will bring the highest prices of any Canadian gas sales of which we know."



Only Phillips has so far entered into a gas contract with Westcoast. Other companies with interest in the Savanna Creek development are Northern Natural Gas Producing Co., 32½ per cent; Husky Oil & Refining, Ltd., 32½ per cent; Canadian Anaconda Oil Co., Ltd., 5 per cent; and Target Petroleum, Ltd., 2½ per cent. Northern Natural has proposed a line from Savanna Creek and other Alberta fields to Minneapolis, but plans have not materialized.

The 1 Savanna Creek opened the field in 1954, testing 50,000,000 cu. ft. daily from the Mississippian at about 7,500 ft. Two other producers were drilled, and a fourth test north of the field is under way.

Drilling activity is in mountainous terrain, atop Plateau Mountain which is about 8,600 ft. above sea level—highest surface sites on record in Canada. Drilling has been hampered by long vigorous winters, relatively deep objective, and lack of outlet.

The new outlet will serve several Alberta communities, including Coleman and Blairmore, and Michel, Cranbrook, Fernie, and Kimberley in British Columbia.

Exports to U. S. . . . The proposed line will then connect at Kingsgate, B. C., near the Idaho border, with a gas line proposed by Pacific Northwest. This line would originate at Spokane, Wash., where it would connect with Pacific Northwest's recently completed main line from the San Juan basin of New Mexico-Colorado to the Pacific Northwest region.

Thus, the Westcoast system would connect at two locations with the Pacific Northwest system: Westcoast's Peace River main line would meet the Pacific Northwest main line at Sumas, Wash., and Westcoast's proposed Savanna Creek line would meet Pacific's proposed leg at the Idaho-Canadian border.

Pacific Northwest expansion . . . Pacific Northwest will place its construction plans before the Federal Power Commission in about 3 weeks.

The timing may depend on completion of the company's proposed merger with El Paso Natural Gas Co. Merger was scheduled to be closed by this week.

Pacific Northwest expects to get started on the new construction and addition of compressor horsepower late this year, if FPC approval is granted. The additional construction would increase the company's investment in the system to some $320 million.

Plans for the expansion materialized earlier than was expected. The company said that once the Pacific Northwest market was opened up, it began to develop rapidly. The peak day so far has been 300,000,000 cu. ft. daily through the system. But this figure will be trebled when the new expansion is completed. The line will have a delivery capacity of 1,000,000,000 cu. ft. daily.

If the merger with El Paso goes through, the combined systems will have a capacity exceeding 3½ billion cubic feet per day.

Besides this newly disclosed program, Pacific Northwest already had sizable construction planned for 1957. It will lay more than 1,000 miles of gathering and lateral lines to link with supply sources and sales outlets. Its producing subsidiary expects to drill more than 100 wells during the year. Pacific Northwest also will complete its 8,000-hp. compressor station at Sumas, Wash., the northern terminal of its line.

Delta Drilling Reorganizes

TYLER, Tex.—Delta Drilling Co. has given its corporate structure a thorough going over.

The company, one of the largest drilling contractors with 56 rigs, has merged three subsidiaries into the parent and combined two Venezuelan affiliates into one.

Delta Gulf Drilling Co., Algord Oil Co., and Creek Oil Co., all have been merged into the parent company. In Venezuela, Perforaciones Delta, C. A. has absorbed Perforaciones Guarico, C.A.

Under the new setup Delta Drilling Co. will do all domestic work except

that in the tidelands, which will continue to be handled by Delta Marine Drilling Co., a New Orleans affiliate.

Perforaciones Delta will do all the drilling in Venezuela.

Work in Europe, the Middle East, and Africa will be handled by Cia. Industire Metanifere e Affini (Cima), an Italian affiliate in Rome. Delta has rigs operating in Italy, Spain, and Libya.

Test Hits in South

Lower Cretaceous trend is tapped in Mississippi

JACKSON, Miss.—The California Co. last week opened what appears to be another major field in the deep exploratory play along the Lower Cretaceous trend across southern Mississippi and southwestern Alabama.

Location is in the Cohay area, 6 miles southwest of Raleigh in southwestern Smith County of Mississippi. It is 20 miles northwest of prolific Soso field, which gave the state's Lower Cretaceous play its first big boost when it was discovered in 1953.

Discovery well, 1-5 Central, is productive from the Sligo-Bailey zone, the main productive horizon at Soso. With pay perforated at 11,693-11,702 ft. and 11,758-64 ft., the well flowed at the rate of 314 bbl. of clean oil per day during its first 12-hour gage. Flow was through a 5/32-in. choke under pressure of 1,225 psi., with gas-oil ratio of 632 cu. ft. per barrel. Gravity of the oil is 47.7°.

The discovery is 50 miles southeast of Bolton field in Hinds County, the nearest Lower Cretaceous production on the trend. Along the southeastern extremity of the trend in Mobile County, southwestern Alabama, is prolific Citronelle field, discovered late in 1955.

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watching WASHINGTON

. . . with Bertram F. Linz

Ready on the firing line . . .

THE National Petroleum Council will be a prime target again this year for Chairman Emanuel Celler of the House judiciary committee.

Celler has a package of bills, one of which is designed to put the N.P.C. under wraps. Under it, the council could meet only at the Government's call, with a full-time government official in the chair. It could work only on an agenda prepared by the Government, with complete minutes of what it did.

Celler's bills aren't new. But they mean his committee is likely to hold hearings this year on how the N.P.C. and also the Commerce Department's advisory committee works.

That also isn't new. But Celler apparently is hopeful that continued digging will bring up some dirt that previous probing didn't reveal.

The other bills in the package would require 60 days advance notice to the Government on planned mergers, require government regulatory agencies to give top priority to competitive considerations, and exempt from taxes two-thirds of the triple damages awarded private complainants in antitrust suits.

Tanker lag causes worry . . .

A STUDY of this country's failure to keep abreast of the rest of the world in tanker construction bids fair to be the first of a number of oil investigations to be launched by Congress this year.

The House merchant marine committee is shaping up plans to go into the reasons why less than 3 per cent of the world's merchant tonnage is being built in the U. S. The obvious answer is that it costs more to build ships in this country and, at the moment, lack of steel plate is an additional factor.

The committee's interest in the problem was spurred by the Middle East situation. Surveys have shown that a large number of tankers are building and planned in other countries, but relatively few here.

It has been charged that U. S. shipyards are lagging badly in competing with those in other countries. Last year, less than 3 per cent of the world output was produced here. But in 1955 U. S. yards accounted for 6.5 per cent and in 1954 for 11 per cent.

The committee also will inquire into charges that the shortage of shipbuilding steel persists despite tax write-offs to aid companies in producing it.

Ballooning industry . . .

THE oil industry will be called on to supply the makings for an additional 40,000 tons of synthetic rubber this year.

Early estimates put the 1957 synthetic output at 1,120,000 tons. It is figured that production last year was 1,080,000 tons.

More synthetic will be made abroad, too. Output of the free world is expected to increase to 145,000 tons from 125,000 last year.

Natural rubber production, on the contrary, will drop about 5,000 tons, to 1,895,000 tons. The result will be that synthetic, which represented 38.8 per cent of the world rubber output last year, will account for a flat 40 per cent this year.

Rubber consumption in the U. S. last year ran about 1,435,000 tons, of which 875,000 was synthetic. This year it will reach an estimated 1,500,000 tons, of which 930,000 will be synthetic. Synthetic consumption in other countries will jump from 235,000 to 295,000 tons, but use of natural will drop from 1,310,000 to 1,305,000 tons.

MEN WITH THE PROBLEM are Oklahoma Corporation Commissioners Wilburn Cartwright, Ray Jones, and Harold Freeman. They must make the conservation decision on...

What the Industry Needs in Oklahoma

● Here's what's required, most oil men say, to put the Sooner state where it should be in the realm of enviable operation and regulation.

A NEW attitude on the part of the Corporation Commission is needed to get more effective conservation in Oklahoma.

It would lay the basis for a continued healthy oil industry in the state.

At least that is the view of dozens of producers interviewed by The Oil and Gas Journal. They also emphasize:

... **The industry itself** shares part of the blame for loose practices the survey uncovered.

... **Political expediency** is another factor.

... **But major responsibility** is laid to the Corporation Commission.

Oil men in Oklahoma say the Commission has a number of other duties not related to oil and gas. It has paid little attention to conservation matters. These have been left very largely to its conservation division. And yet the commission frequently fails to adopt the recommendations of its staff.

Down to brass tacks . . . Their specific suggestions for improvement include:

... **Stop waste,** particularly flaring of gas at the wellhead and underground loss of oil through inadequate reservoir control.

... **Look to the future** by making Oklahoma attractive to operators with long-range programs for preserving the present and developing new petroleum resources.

... **Apply consistent policies** to all producers equally, so operators can plan ahead with reasonable assurance how the statutes will be applied.

... **Give engineering evidence** more weight in commission decisions than at present.

... **Start spot policing** of producers' reports and practices. An occasional penalty for violations would tone up compliance and keep the industry on its toes.

... **Modernize procedures** to put the commission's work on a more business-like basis and eliminate some work considered an unnecessary burden on both producers and the conservation staff.

What's the Law?

Only two things need to be done to Oklahoma's conservation statutes, in the opinion of many operators. They want to:

... **Codify them** for ready reference.

... **Modernize the basis** for setting allowables.

The Oklahoma laws were enacted piecemeal over a long period of years. Some of them are parts of other statutes. Often later enactments repealed or amended earlier ones. As a result, the applicable laws are scattered through several volumes of the statutes at large. A reenactment in codified form would be a big aid to proper enforcement.

The only statutory basis for allowables in Oklahoma is the producibility of a well. This was perhaps the only known method at the time that law was written. But it has been outmoded for many years.

As a matter of actual practice, the commission is using other methods, without statutory support. For example, the yardstick formula applied to allocated pools *(The Oil and Gas Journal, January 7, page 72)* is based on a "log-log curve" which includes a depth-bracket factor.

Some oil lawyers suggest the law should be brought up to date and in line with the actual practices in other states. Statutes should give the commission authority to base allowables on a formula which includes:

... **A depth factor** to give considera-

tion to costs of drilling and producing.

. . . **An acreage factor** to give consideration to the volume of oil in place.

. . . **An MER** (maximum efficient rate of production) to give consideration to the type of reservoir drive and to prolong the energy source.

The regulations . . . The current Oklahoma conservation regulations were adopted by the commission in 1946, following recommendations of a large industry committee.

One admitted object in that draft was to give the commission wide lattitude and discretion in interpreting and applying the conservation statutes.

Many operators say it is now time for another general revision. They think the regulations should give effect to modern engineering practices, embody the experiences of other states, and be more specific in spelling out the laws applying to particular situations.

Two years ago the commission appointed another industry committee to draft a general revision. The group worked long and hard and brought in a comprehensive report. The commission scheduled a hearing on the proposals, but then cancelled it. Nothing has been done since.

"Quite naturally," said one of the members of that drafting committee, "there were some things in there that didn't suit everybody.

"But such objections ought to be threshed out in public hearings. There were a lot of constructive proposals. It should be revived and made the basis for a new study of the whole conservation setup."

Staff and budget . . . Most operators declare they have found the commission's conservation staff reasonably adequate, competent, and consciencious.

But many say the field men have too much ground to cover, particularly in the busy areas. A frequent suggestion is that the staff should be augmented with a few petroleum engineers. The pay scales should be increased, if necessary, to attract and keep technically trained personnel.

"We all pay a special tax of ⅛-cent per barrel of oil produced, the money to be used solely for administration of the conservation laws," explained one producer.

"But while the tax is earmarked for this one purpose, the legislature won't let the commission spend it all. As a result, I understand that there's a surplus in the fund. The commission ought to be free to spend this fund to enlarge its staff and pay whatever salaries are necessary to get competent engineers and other specialists. That's what we're paying the tax for."

The commission also should bring in a professional methods-analyst to go over its entire operation and draw up a proposed plan of procedure, one producer suggested.

"This should include such things as a job analysis, a manning table and pay scale, report forms, filing system, statistical work, field offices, delegation of authority, hearings procedure, and so on. Nearly every good-sized business firm does something like this every once in a while. The commission's regulatory procedures ought to be as progressive as the industry it regulates.

"The commission wouldn't have to adopt everything these outside experts might propose, but at least it could make a start toward modernizing procedures, and would have something to shoot at."

More Police Work

The biggest trouble seems to be that the commission does not police its regulations effectively. It depends too much on the good faith of the industry.

"Your conscience is your guide in Oklahoma," said one man. "That's particularly true in the unallocated areas. There you can just about make your own rules. You can violate both the law and good production practices and get away with it with impunity, if you're so inclined."

Prohibition all over . . . "Conservation is about like prohibition in Oklahoma," said another. "Lax enforcement has led to a general contempt for the law.

"If the commission would just crack down on a few violators now and then, and impose the penalties provided in the law, the rest of us would get our skirts clean pretty darned fast."

"Most of us want to be honest, but we don't want to be the only one honest," explained another operator.

"It's just like the income tax. Suppose the Internal Revenue Service should announce that it will not audit any returns below $100,000. What would happen to tax collections and to the personal honesty of about 99 per cent of the people next April 15?

"The Corporation Commission is doing just about the same thing by exempting the unallocated areas from virtually all regulation and inspection."

Wavering policies . . . Inconsistent and unpredictable application of the regulations by the commission is another frequent complaint.

The commission seems prone to act on particular cases without much regard to precedent, policy, or effect on other fields.

Such a special order or ruling may be perfectly fair to the parties immediately concerned, but may give them an advantage over operators in other areas. The result: Many operators complain they never know where they stand with respect to the regulations, nor how to anticipate commission action.

"Numerous instances have arisen," said one, "where the commission will issue almost any exception to its previously issued orders, provided there are no objections from royalty or working interest owners.

"The most serious need is a uniform and impartial enforcement of the regulations without allowing exceptions except in very special cases."

For example . . . Here's a recent instance of this:

A discovery well was brought in at 9,000 ft. in Caddo County, an allocated area. Under the yardstick scale as then applied, this well would be entitled to an allowable of 47 bbl. per day. The operator applied for, and was given, an allowable of 119 bbl. per day for this and future wells in the field. Only basis for the change was his own statement. He claimed cost of development was so high the wells would not pay out within the normal time without higher allowables.

There was no opposition at the hearing. Other operators apparently missed the significance of the hearing announcement. Now, some of them are disgruntled. They say that this operator's cost estimates should be subject to rebuttal. Others might be able to develop the field at much less expense.

But their chief gripe is that:

. . . **One producer** managed to get a higher allowable simply for the asking.

. . . **The commission** in this case ignored its yardstick formula which was supposed to apply state-wide to all allocated areas.

Operators cite this case as an example of how the commission ignores its own rules and fails to follow a consistent or foreseeable policy.

Voice for Engineers

A large number of producers who operate in several states say the Oklahoma Commission does not give as much consideration to engineering evidence and technical testimony as do regulatory bodies in most jurisdictions.

Some claim the reasons are these: The conservation division does not have enough engineers on its staff; the commissioners themselves are not sufficiently familiar with the subject to give adequate weight to technical recommendations of the staff on final decision.

Whatever the reason, operators say they have virtually given up trying to base a case on engineering data.

One of them said:

OIL AND POLITICS have to mix in Oklahoma. The state's biggest business also poses a big problem for its political leaders.

"Numerous times in the past it is felt that the technical and engineering evidence presented has been outweighed by political expediency, especially in matters where there is evidence of considerable objection from royalty owners. Some means or procedure might be set out by the commission whereby it would clear all such matters through the technical and engineering staff, and then give more weight to their recommendations."

Another engineer was more sarcastic: "The way to win a case before the Corporation Commission is to parade a bunch of farmers and local politicians through the hearing as your witnesses. That's a lot better than any factual evidence."

Hearings conduct . . . There are few complaints about the commission's conduct of hearings, except for the monthly statewide market-demand hearing.

"The commission has access to all pertinent information about the demand for Oklahoma crude, but it doesn't know how to evaluate this information," according to one crude buyer who regularly attends the proration hearings of several states.

"Where there are conflicting sets of figures, such as estimates of current production, the commission will use one set one month and another set another month. It seems to give more weight to hearsay evidence than to reliable statistics—and more weight to what producers say they want to sell than to what purchasers say they can dispose of."

Another purchaser was much more blunt:

"The market-demand hearings are a farce. The commission doesn't seem to want any real testimony on demand, and disregards common rules of evidence. It lets producers and other witnesses cross-examine purchasers about things entirely outside their knowledge and having no bearing on the subject of the hearing. The purchasers have been browbeaten and embarrassed so often that none of them dares to take the stand and testify about the reasons for his company's nominations. The result is that the commission never gets the real facts."

Some operators complain that the commission doesn't send out adequate notices of scheduled hearings.

"Many a time we have got notice that a hearing had been scheduled on some matter vitally affecting one of our operations, but the hearing had long since been held and the order issued before we got the so-called advance notice," one company attorney said.

"We subscribe to two legal services that carry the commission's calendar, and have a couple of people here who do nothing but clip these notices and check them against our operations. That's the only way we can tell that there is something pending that might affect us."

Facts and Fancy

"How the conservation department keeps its files—if it keeps any—is a mystery to me," one man said.

"Many and many a time I have had some of the conservation officers call me from Oklahoma City to ask me what the field rules are in some area or another. All he could find was that my company's name was the top one on the title of the docket that led to setting up those rules, and he had to call me to find out what the rules said."

"I wish you would tell me what the commission does with all the reports it is supposed to get," said one big producer.

"Look at this long list of report forms authorized by the conservation division. They appear to cover just about everything. On the face of it, you'd think that Oklahoma had a very complete statistical control over drilling, plugging, potentials, production, allowables, and everything else.

"But what happens to these reports? If the commission ever totals them up or makes any use of them, I haven't seen any evidence of it.

"Why, the commission doesn't have any idea how many wells have been drilled in this state. It can't guess within two or three thousand how many wells in the state are capable of producing."

Machines . . . Two years ago the commission set up an I.B.M. punch-card system to improve its statistical work.

This was put in with the financial and manpower assistance of a number of oil operators, who hoped this would lead to better knowledge of activities in the state and better control of production practices.

The results have been a disappointment.

"The only thing the machine accounting has been used for is to make up lists of the wells operated by each company," one operator explained.

"The commission undertakes to list every one of our wells in the state," he said, "but what purpose this serves is

beyond me. We have our own company records which are better than the commission's. And the commission never does anything with the records it keeps.

"Every month we get a report on our own wells with a request to check it. We always find 30 or 40 errors, note the corrections, and send it back to the commission. Nothing more is ever heard about it. We never know whether they have made the corrections on their records, or whether they have checked up on us to see that we are telling the truth.

"We never have a chance to see the reports on other companies, and we doubt that there is any check on them either. If an operator is careless—or desires to be dishonest—he can let the commission have an incomplete or erroneous record of the number of wells he has, their locations, potentials, allowables, and so on."

Rigged Allowables

But one good thing did come out of the I.B.M. setup. It uncovered a "lost" field.

When the machine accounting was first put in, an attempt was made to list every producing field in the state. In the course of this check, a good-sized pool was "discovered" in Lincoln County which the commission didn't know existed. It had never appeared on the records.

This pool had produced and marketed more than 1,000,000 bbl. of oil without the commission's knowledge. It was discovered (statistically) by a secondary purchaser, a pipeline company that was taking the oil from a primary purchaser who gathered it along with its own production in the area.

Set your own allowables . . . Fields may be lost because of the commission's poor statistical checks, but apparently no allowables are lost that way.

One big producer, after enjoining secrecy, admitted he has used the commission's laxness to raise the individual allowables on some of his wells. It happened like this:

"Just to test the commission, we deliberately inserted some errors when we returned our monthly I.B.M. report. They were the type of errors that could be caught easily, but we never heard from the commission about them.

"We figured that, this being the situation, some of our competitors might be getting away with murder by giving false reports. I'll have to admit that we broke down and did it ourselves.

"For example, we have many wells that have only a partial allowable because they are on less than a full spacing unit. Where this showed up on the commission's I.B.M. records, we let it stand for a while. Then we raised a few of them to a full allowable, in the guise of correcting errors, just to see what would happen.

"Nothing happened, so on the next report we raised a few more. By this process we have gradually got most of our partial-allowable wells up to full allowables, and nobody is the wiser.

"It's wrong, but we figured that others were doing the same thing. The commission doesn't seem to care enough to check the records, and there's no opportunity for one operator to check another's allowables."

Underage problem . . . Oklahoma permits producers to accumulate underages. Some operators complain they are greater than those allowed in other states.

In Oklahoma, the policy works like this: If for any reason a producer does not produce or sell his full allowable, he can carry the underage to his credit for several months and produce it when conditions are favorable.

When the total of accumulated underages is rather large, as frequently is the case, the commission has no accurate knowledge of the volume involved and has no control over this production. This is a partial explanation of why production often exceeds allowables by substantial amounts.

An explanation . . . Oklahoma's failure to have a statistical control system comparable to other states apparently traces to this theory: Unallocated areas should be exempt from nearly all regulation and reporting requirements as well as exempt from per-well allowables.

The explanation is that unallocated wells are small and their operators are largely individual independents who do not have extensive office organizations.

This theory is ridiculed by some of the larger operators. One of them said:

"Every time it has been suggested that operators in the unallocated areas should comply with the regulations and send required reports to the commission, somebody objects that the 'little fellows' aren't capable of understanding the regulations or of filling out reports.

"Apparently the commission is completely swayed by this argument.

"I can't understand how a man can be in the oil business and be unable to read and write—or at least able to hire somebody to read and write for him.

"Small operators have to follow regulations and file reports in other states."

What to do . . . Specific suggestions for making the allowables more equitable and more under the control of the commission were made by various operators. These include:

. . . Reducing unallocated leases to something more closely in line with the usual definition of a stripper field, say 10 bbl. per well per day or less.

. . . Eliminating lease allowables for all other pools and putting them on a per-well basis.

. . . Reducing underproduction that can be carried for a period of months.

. . . Requiring producers to file lease reports monthly with the commission, to be used in checking production and setting allowables.

. . . Issuing a periodic proration schedule giving the allowables for every lease and well in the state.

. . . Developing a new yardstick for allocated wells which would give consideration to MER, depth, and acreage factors.

Waste of Gas

Allegations that natural gas is being wasted in Oklahoma have been made frequently in recent years.

Many operators interviewed by the Journal cited evidence to substantiate this. They included cases of:

. . . Unnecessary flaring of casinghead gas.

. . . Improper gas-oil ratios.

. . . Improper spacing, and failure to require ratable take in dry-gas fields.

. . . Loss of reservoir pressure through inadequate special field rules in combination or gas-cap fields.

One operator summed up the situation thus:

"A big conservation aid that should be undertaken by the commission in connection with reservoir control, avoidance of waste, protection of correlative rights, and prevention of flaring would be some manner of limiting the amount of casinghead gas flared from oil wells.

"None of the unallocated reservoirs and only a very small percentage of the allocated pools are governed by field rules which specifically limit the amount of gas that may be vented from oil wells. The field rules covering the

Last of Series

The article on these pages detailing what Oklahoma oil men consider to be the industry's needs in the state is the last of a three-part series.

The stories were based on an Oil and Gas Journal staff survey. The first article appeared in the December 31 issue. Together they show that most oil men believe conservation is being weakened . . . that the proration system is the crux of the problem . . . and that ill effects of the system are causing bad practices in the field and endangering the future of the Oklahoma industry.

Southeast Eureka pool are one of the few which definitely limit the amount of flared gas. It should be possible to incorporate such a rule in all applicable areas."

What it means . . . The Journal's inquiry into Oklahoma practices leads to these general observations and conclusions on:

. . . Basic objectives. Prevention of waste, protection of correlative rights, and maximum ultimate recovery are being ignored both by the Corporation Commission and by a large share of the industry.

. . . Regulation. It is not applied uniformly, impartially, and equitably to all producers. This is discouraging to those who want to comply and threatens to undermine the industry's long-range future in Oklahoma.

. . . Procedures and regulations need to be reviewed, reoriented, and modernized throughout.

. . . A new attitude. A renewed devotion to the cause, a little bit of the crusading spirit, is needed to return Oklahoma to the forefront of conservation which it enjoyed 20 years ago.

What to do . . . Some operators are frank to admit they like things the way they are.

It's easy to do business in Oklahoma. No red tape. No snoopy inspectors. No penalty for infractions. An oil man can operate his properties just about as he pleases.

Others don't approve the situation but are grimly fatalistic about it.

But still others—the big majority—deplore Oklahoma's drift away from recognized conservation practices. They would welcome, and participate in, a genuine, objective, industry-wide effort to correct the situation.

"Let's keep our feet on the ground," said one typical producer. "Regulation must be practical, not theoretical. We don't need a big bureaucracy. Most producers want to comply with the rules and follow sound production practices. The industry can police itself 90 per cent of the way.

"All we need is a modern set of workable regulations, impartially administered with the minimum red tape and government control. But there has to be some enforcement and some encouragement to comply.

"Some states have too many controls and too much paper work. Some theoretical conservationists have suggested procedures that are entirely impractical. We don't want to go that far.

"But regulation in Oklahoma has become so 'practical' that it amounts to almost no regulation at all."

Processing briefs

Fire of undetermined origin caused damage estimated at $1,000,000 last week at Shell Oil Co.'s Montreal East refinery. The fire destroyed six tanks with a combined capacity of 200,000 bbl. The blaze started in a pumphouse. Eight persons were injured, one seriously. The fire was brought under control in 3 hours.

American Oil Co. has awarded Fluor Corp., Ltd., a contract to build a gas-treating and sulfur-recovery plant at the new Yorktown, Va., refinery. The unit will produce about 50 tons of elemental sulfur per day from sour refinery gases. Molten sulfur will be shipped by tank car to eastern markets. Construction is due to start in July. The unit will go on stream by next November.

Kerr-McGee Oil Industries, Inc., has acquired all the capital stock of Cato Oil & Grease Co., Oklahoma City. Cato will continue to operate as an individual company, manufacturing and marketing oils and greases under its own trade names.

Dorchester Corp. has acquired the gasoline plant of Texon Gas, Inc., in the Big Lake field in Reagan County, Texas. Plant capacity is about 6,000 M.c.f. of gas daily. Dorchester has natural-gasoline plants at White Deer, Tex., and Hooker, Okla. It is a wholly owned subsidiary of Oil & Gas Property Management, Inc., Dallas.

A new wrinkle has been added to the business of moving storage tanks. Standard Oil Co. (Ind.) shifted one 800 ft. to a new location the way you would a house. The tank weighed 200 tons empty. It was 50 ft. high and almost 94 ft. in diameter, too big to skid or float along the route where clearances were sometimes measured in inches. So the company hoisted it onto house-moving dollies and cut in half the time it would take to tear it down and reassemble it again. It also saved two-thirds of the cost.

Three major refiners have received certificates of necessity for quick tax writeoffs on new refining facilities—primarily new catalytic-reforming capacity.

The Texas Co. was granted rapid amortization on 54 per cent of $921,700 and 65 per cent of $3,598,500 for units at Los Angeles. Esso Standard Oil Co., Inc., got 50 per cent of $640,000 and 65 per cent of $3,696,000 for units at Bayway Refinery, Linden, N. J. Socony Mobil Oil Co., Inc., was granted fast writeoff on 15 per cent of $7,000, 45 per cent of $892,000 and 65 per cent of $3,948,000 at East St. Louis, Ill.

Delhi-Taylor Oil Corp. will finance new refinery units at Corpus Christi with $7,000,000 borrowed privately on secured notes sold to Mutual Life Insurance Co. of New York and New York Life Insurance Co. The money will go for a new 10,500-bbl. per day Platforming unit, Unifining facilities with a total feed capacity of 15,000 bbl. per day, and a Udex extraction plant capable of handling 5,000 bbl. per day of reformate. Completion of the new facilities is slated next June.

Shell Oil Co. has contracted with Fluor Corp. for the building of a 2,400-bbl. per day aviation alkylate plant at the company's new 50,000-bbl. per day refinery at Anacortes, Wash. The unit will produce enough alkylate for 800,000 bbl. per year of 115/145 grade avgas. The unit will use the sulfuric-acid process, alkylating isobutane with mixed olefins. Completion is scheduled for mid-1958.

Also for Refiners . . .

There were differences of opinion last week over whether the product-price increases made necessary by the crude-oil price hike could be made to stick (P. 64) . . . The trend in refining development of the Royal Dutch-Shell Group is away from the Western Hemisphere and more toward Western Europe (P. 74) . . . American Petrofina's refining capacity was raised 16,000 bbl. daily to 25,000 bbl. last week when it bought American Liberty Oil Co. (P. 74) . . . The first two Gulfining units have gone on stream at Gulf's Port Arthur refinery (P. 79) . . . Kellogg will build Standard of Ohio's 60,000-bbl. Toledo refinery (P. 82) . . . Two more natural-gasoline plants are going up in northeastern Colorado (P. 82) . . . Brazil's Manaus in the Amazon jungles was dedicated last week (P. 89).

PLUS THESE TECHNICAL FEATURES: Report on alkylation of mixed feed (P. 108) . . . How to estimate yields in catalytic cracking; a correlation chart and selected references (P. 126) . . . A look at how materials compare in transferring heat (P. 129) . . . and a new series on corrosion of ferrous-metal tubing (P. 131).

—Photo Courtesy Houston Chronicle.

Revived Oil Field Moves in on Houston

HOUSTON. — Pierce Junction, the tricky old salt dome which brought a rash of new drilling activity to the Houston area 2 years ago, continues to defy man-made boundaries.

The exploration revival started on the east flank of the historic field in 1954 and now has spread 4 miles westward to Houston's South Main Street. Drilling rigs are almost as thick as tourist courts along South Main, and some operators are eying new middle-class residential areas only a few blocks away.

If the play continues to spread, backyard wells may help pay for new suburban homes just as current producers have made the motel business thrive.

Since spacing regulations don't apply on salt-dome structures, all that's needed to join the play is a lease big enough to hold a rig. And in some areas that's hard to find. At least one operator spotted his rig on the west side of Main Street and drilled directionally to his small lease underlying a tourist court on the opposite side of the street.

Like most recent wells in Pierce Junction, this one was a producer.

Success in the revived field has sent leases and royalties sky high. Some landowners are asking—and getting—25 or 30 per cent royalty. And the City of Houston recently leased its unsightly Holmes Road garbage dump for $25,200 bonus plus ⅜ royalty. The city already has seven producing wells on the 300-acre tract.

With the present allowable of 91 bbl. per day, each well on city property will add about $25,000 annually to the public till, officials figure. The take would be higher except for an agreement which gives heirs of the former landowner ⅛ royalty.

County officials, who haven't had much oil experience so far, are known to be studying a plan for possible leasing of rights-of-way.

Barditch drilling already is a familiar sight in some sections of Pierce Junction. Texas & New Orleans Railroad Co., an affiliate of Southern Pacific Lines, has a string of producers right beside its tracks and just a few feet from Holmes Road (see photo).

How it started . . . Located at the southwest edge of Houston, Pierce Junction field has been producing oil since 1921. From then until the end of 1954 the field yielded more than 47,000,000 bbl. of oil, but its output had dropped to about 3,000 bbl. a day.

Late in 1954 Scurlock Oil Co. set off the current play with discovery of oil in the Vicksburg sands on the east flank. The company's 1 H. C. Cain, completed at 7,103-17 ft., produced 141 bbl. of oil per day.

The new search quickly spread around the north flank and then to the west flank of the structure. As major oil companies and independents joined in, the revived field became the most active drilling spot on the Texas coast.

During 1955 approximately 50 wells were completed at Pierce Junction. Texas Railroad Commission records show more than 200 wells drilled in 1956, most of them producers. Many of the wells are capable of producing 150 to 300 bbl. daily.

Despite a recent cutback in the allowable, Pierce Junction is now producing about 20,000 bbl. daily.

One of the most prolific leases in the still-expanding field is a 448-acre tract owned by the Shamrock Hilton Hotel. Magnolia Petroleum Co. and Stanolind Oil & Gas Co. are now producing about 800 bbl. per day from that lease, and they're keeping a rig busy looking for more oil. The tract formerly was owned by Glenn McCarthy, famous Houston wildcatter, now developing properties in Bolivia.

Shell Leans to West

● Western Hemisphere is gaining a more prominent role in world-wide operations of the Royal Dutch-Shell Group

THE Royal Dutch-Shell Group, long conceded to be the mammoth of the European oil industry, has actually become as "western" as it is "European."

The intricate network of the group contains 500 companies engaged in all phases of the oil industry. They operate in 140 different countries of the world, use more than 50 separate currencies in their transactions, and deal in every major language in the world.

At the top of the hierarchy are the two holding companies which give the group its name—Royal Dutch Petroleum Co. and Shell Transport & Trading Co.

Some of the intricacies of such a far-flung operation, plus the group's "westernization," were explained last week in an unprecedented appearance before New York's Security Analysts by John H. Loudon, president of Royal Dutch Petroleum.

Loudon's company, with headquarters at The Hague in the Netherlands, has a 60 per cent interest in the group. Shell Transport & Trading, headquartered in London, holds the remaining 40 per cent interest.

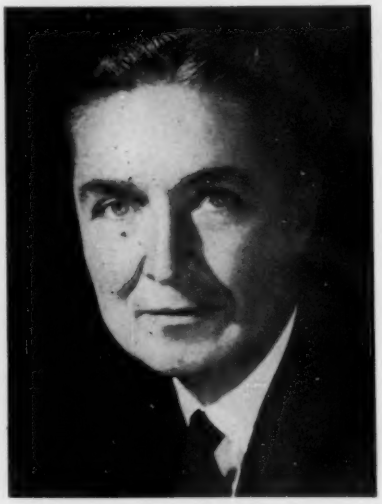
The group is very decentralized, but in spite of the autonomous nature of the individual companies, the twin nerve centers are The Hague and London. The Hague furnishes technical advice. London is the commercial and financial center of the group.

Here are a few of the things that Loudon revealed about the change from a once strictly European character of the group:

...More than half of production—1,930,000 bbl. daily—comes from the Western Hemisphere. Loudon's figures were all 1955 totals, but he added that in the first 10 months of 1956, production was up 10 per cent.

He cited Venezuela, the group's biggest single source of crude, as an example. In 1955, all Latin America accounted for 772,000 bbl. daily of the crude output. Venezuela alone is now producing more than 900,000 bbl. for the group. The U. S. and Canada accounted for another 357,000 bbl. daily in 1955, and that has certainly been increased.

...The group's refining activities have long been centered in the Western Hemisphere. This area of the world accounted for much more than half the 1,964,000 bbl. daily refined by the group's companies in the year 1955.



J. H. LOUDON
...Some intricacies explained.

The trend in refining is away from the west, however. Western Europe now ranks about equally with North America and Latin America from a refining standpoint.

...About half of the sales of petroleum products of companies in the group are made in the Western Hemisphere. Continental Europe accounts for the next largest single sales area, with the Middle-Far East next.

...Americans own more than a fourth of the capital of Royal Dutch Petroleum. Loudon gave no comparable figures for Shell Transport & Trading.

This large percentage of American capital would lend credence to the speculation that American capital might hold the lion's share of holdings in the entire group.

The future . . . Loudon said that in every country in the world where the group now has production, it is carrying on active exploration programs aimed at expanding and extending present limits.

In addition, exploration programs are under way in the Sahara Desert, off the coast of Borneo, off Qatar, in East Africa, Nigeria, Cuba, Guatemala, France, Libya, Turkey, Pakistan, and New Zealand.

He pointed out that the group has recently built refineries in Australia and Cuba, and took part in the building of one in India. He said plans for other refineries include Ireland, Germany, Turkey, Japan, and possibly one or two others.

The Royal Dutch president summed up his analysis of the group headed by his company with what he calls a "highly important advantage" the group has. He said the very scope of the group's operations insure against "a mortal wound" by one single blow. The group's strength lies in the diversity and multiplicity of its activities.

Petrofina Signs Deal

American Liberty sold to Belgians for $35,000,000

DALLAS.—American Liberty Oil Co. formally signed a contract here last week for the sale of about $35,000,000 of integrated oil properties to American Petrofina, Inc.

Terms call for payment partly in cash and partly in common stock. The exact price and terms, however, will not be fixed until auditing and engineering reports are completed on the American Liberty properties in 2 or 3 months.

Owner of the great bulk of American Liberty stock currently is Toddie L. Wynne, Dallas oil man, and his family. Wynne is president of American Liberty.

The Texas Presbyterian Foundation is the only other beneficiary of the sale. The foundation is expected to realize about $2,000,000 from a stock interest in the company which it received as a gift from the Wynne family.

As its part of the deal, American Petrofina will gain:

...14,000,000 bbl. in reserves of crude oil, natural gas, and gas liquids in Louisiana and Texas.

...A 16,000-bbl. refinery at Mount Pleasant, Tex.

...800,000 acres of undeveloped leases in Texas, New Mexico, Louisiana, Wyoming, Utah, Mississippi, and Montana.

...165 miles of pipeline, mostly 4 and 6-in., along with 17 pump stations. These are now operated by American Liberty Pipeline Co., an affiliate.

...400 retail outlets in North Texas and southern Oklahoma, together with the marketing brand name "Amlico."

Wynne will retain rights to both the American Liberty Oil and American Liberty Pipeline names together with certain unspecified holdings. The Dallas oil man said he planned to continue in the oil business and to rebuild his holdings.

Wynne's association with American Liberty dates back to its formation in 1931 during the East Texas field's early

days. Dudley S. Golding and Clint Murchison were chief owners at that time. Wynne was general counsel and one of the incorporators. Wynne and Murchison were primary owners by 1949. And Wynne bought out Murchison's interest for a reported $8,000,000 later that year.

Petrofina's growth . . . American Petrofina is a subsidiary of Cie. Financiere Belge des Petroles, S.A., based in Brussels. In its first step at becoming a fully integrated U.S. company, Petrofina bought control of Panhandle Oil Corp. last year *(The Oil and Gas Journal, September 10, 1956, page 88).*

The firm now has about 30,000,000 bbl. of reserves; 25,000 bbl. of refining capacity; 650 retail marketing outlets; more than a million acres of undeveloped leases; and miscellaneous pipeline and cycling-plant properties.

Imports Law Sought

Coal industry wants quota on all crude and products

WASHINGTON.—The coal industry fears a new flood of foreign oil when the Suez Canal is reopened. Last week it broadened its demands, asking Congress to impose a quota on residual fuel and also all imported oil.

An industry-backed bill setting up a quota system for imports of crude oil and all products was introduced in Congress by Rep. Robert C. Byrd of West Virginia. In the last two sessions, Byrd fought for a quota on residual only.

"When the Suez Canal is reopened to tanker traffic, many of the shipping bottoms that have been reactivated to meet the fuel crisis in Europe will unquestionably be diverted to the haulage of crude into the United States.

"This prospect poses a serious threat to America's coal industry, for the more crude that enters, the more residual will harass coal producers. For this reason it is mandatory that Congress enact legislation to prevent excessive imports of crude. . . ."

Other oil bills . . . More than a score of bills affecting the oil industry were introduced during the first week of the 1957 session.

For the most part they were measures which got no action last year, such as the Patman, Kefauver, et al., bills to override the Supreme Court's "good faith" decision in the "Detroit" case.

Only one bill to exempt independent gas producers from federal regulation was offered. Its author was Rep. John B. Williams of Mississippi.

LeTourneau now building a . . .

Rig to Lower Offshore Costs

LONGVIEW, Tex.—R. G. LeTourneau, Inc., is building a super-efficient offshore mobile drilling platform for Deepwater Exploration Co.

The new equipment will feature radical changes in design. Cost is $1.5 million with delivery set for this June.

R. L. LeTourneau, vice president of the heavy-equipment firm, said the new platform will answer the oil industry's need for medium-depth offshore workover or drilling operations.

Dimensions are: Over-all length, 121 ft.; width, 118 ft.; depth of hull, 12 ft. The unit can be lowered to the water, floated to a new location, then raised again on electrically powered legs.

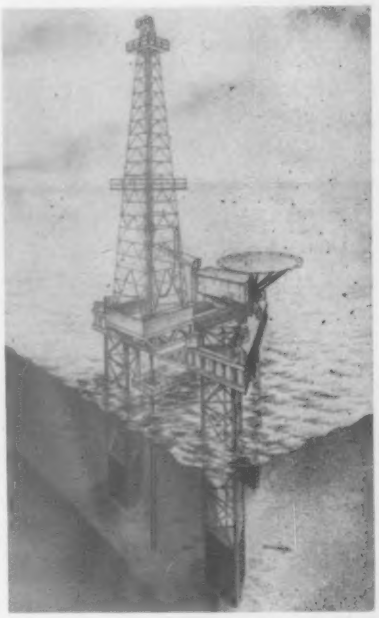
LeTourneau says the platform's versatility promises to lower offshore-drilling costs. Features making this possible are its ability to:

. . . **Change work locations** quickly.

. . . **Skid the entire derrick,** d r a w works, and substructure—all as one unit—off onto a fixed platform for workover purposes.

. . . **Complete wells** drilled by more expensive units.

. . . **Shift the substructure,** including derrick and draw works, laterally for ease in servicing multiple wells, or for facility in final adjustment over a proposed location.



. . . **Drill two wells** from same location in water depths up to 70 ft. This is made possible by lateral shifting of the drilling machinery over a 26-ft. wide deck slot.

FPC to make recommendations:

Congress to Hear Gas Views

WASHINGTON. — Administration views on regulation of independent gas producers may first be disclosed in the annual report of the Federal Power Commission, due to be sent to Congress this month.

The FPC is expected to recommend, at least, that the certificate requirements on producers be abandoned. It may suggest a Harris-type bill, with built-in safeguards for distributing companies and consumers.

The commission has run into a number of tough problems in the more than 2½ years since the Supreme Court decision in the Phillips case. Some of these may be touched upon.

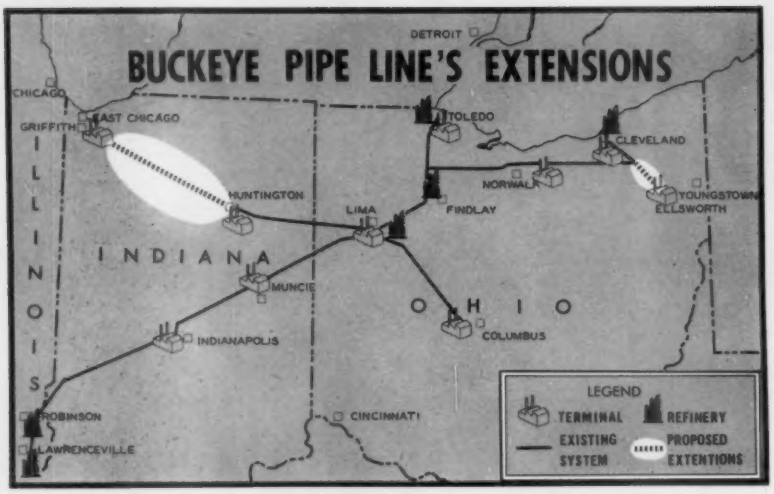
If it doesn't go so far as to call for release of producers, it is expected to ask for amendments to the Natural Gas Act which would provide a yardstick for dealing with prices.

The FPC's effort to give pipeline companies fair field price for the gas they produce themselves was thwarted by the courts. But some in the commission, realizing that higher prices for gas must come if new reserves are to be found and developed, still believe that is the proper approach.

There is also some support for the idea of regulating prices on an area basis. This would greatly simplify regulation, if it could be worked out so that lowest-price producers could be brought up to the area average without heavy penalty on consumers.

Backlog of filings . . . Despite its efforts to catch up, the FPC still has a heavy backlog of producer filings to deal with. It disposed last month of 20 more applications than were filed. But it still had 1,899 to act on.

Better progress is being made on rate filings. A total of 19,337 have been acted on since mid-1954. But it has some big cases pending in the 358 increases totaling $25,648,000 a year that have been suspended for investigation.



Competition waxing hotter . . .

. . . Buckeye to Enter Chicago

CHICAGO.—The big Chicago products market—already a hot competitive battleground — is getting still another source of supply this summer.

Buckeye Pipe Line Co. will convert an 8-in. crude line from Huntington to Griffith, Ind., to products service (see map). This will extend its midwest products system westward to the Chicago area, giving shippers from Toledo and other refining areas of Ohio a common carrier into the market.

Buckeye, an independent pipeline, will spend an estimated $2 million on the project. It involves the takeup and reconditioning of 116 miles of 8-in. crude line and construction of some new line on the route. Sheehan Pipe Line Construction Co., Tulsa, has the contract. Construction is scheduled to start in April. Target date for completion is July. A terminal to serve the Chicago area will be built at Griffith, the site of Buckeye's crude-oil tank farm and pump station.

Other lines planned . . . Besides this new line into Chicago, the products supply will be increased from at least two other sources.

Ohio Oil Co. plans a 350-mile, 12-in. line from Wood River, Ill., with capacity of up to 100,000 bbl. per day *(The Oil and Gas Journal, November 26, 1956, page 49)*. Great Lakes Pipe Line Co. is laying a 68-mile, 12-in. line from its juncture with the Badger system along its existing 6-in. line eastward into Chicago *(The Oil and Gas Journal, December 24, 1956, page 51)*.

Buckeye also will extend its Toledo to Cleveland products line to the Youngstown, Ohio, area (see map), with another conversion project. It will convert 32 miles of an old 8-in. crude line between Buckeye's Mantua, Ohio, pump station and Ellsworth, Ohio, location of a new terminal. Construction will start late this summer. Completion is scheduled for November.

When these extensions are completed, Buckeye will be able to handle shipments of gasoline and distillates to the major consuming areas of Cleveland, Toledo, Columbus, Indianapolis, Chicago, and Youngstown.

Tax Incentive Urged

Oil men seek to increase shale depletion allowance

WASHINGTON. — A 17-member delegation met with government officials last week to urge that the depletion allowance on oil-shale be increased from 15 per cent to 27½ per cent.

The group, headed by A. C. Rubel, president of Union Oil Co., and Union Engineer Tell Ertl, conferred with officials of the Interior Department and members of Congress.

The delegation argued that if a higher depletion allowance were extended to oil shale, there would be increased work toward extracting oil from the vast shale deposits in the Colorado-Wyoming-Utah area. Shale-oil reserve estimates for the area have ranged up to 900 billion barrels.

Ertl is in charge of Union's new $5-million shale pilot plant near Grand Valley in western Colorado. The plant is about ready to start processing oil-shale *(The Oil and Gas Journal, December 17, 1956, page 94)*.

Ratable Take Killed

Judge voids commission's order for Puckett field gas

AUSTIN.—A federal court here last week reversed a Texas Railroad Commission order requiring ratable take from Puckett Ellenburger field of Pecos County, West Texas.

Relief was sought in separate suits by Phillips Petroleum Co. and Permian Basin Pipeline Co. from the order requiring Permian to take gas ratably from an Atlantic Refining Co. well. The order also required Permian to take additional gas from Atlantic over its normal allowable at the expense of Phillips well allowables until prior overproduction of the Phillips wells had been made up.

Judge Charles O. Betts of the Ninety-eighth District Court ruled in favor of Phillips and Permian. The companies argued that Permian's take of gas from Phillips is by private contract and that Permian facilities are not a public utility and need not be apportioned among producers in the field.

Atlantic Refining and the Railroad Commission contended the gathering system and a carbon dioxide plant in Puckett are owned by Permian, the common purchaser in the field, and as such are subjected to ratable use by all producers in the field. If these facilities are offered to one producer, they argued, then they must be offered to all on an equal basis.

The State of Texas, acting for the commission, gave immediate notice of appeal. And Atlantic said it intends to intervene in the appeal action.

Harbor-Area Lease Awarded

LOS ANGELES.—The Los Angeles City Council has awarded a lease to a group of southern California men on all city-owned submerged lands seaward from the Los Angeles Harbor breakwater.

The exact acreage involved will have to await determination of just how much land the city owns beyond the breakwater. Also, before any actual drilling operations can begin, clearance must be obtained from federal and state agencies concerned with navigation hazards, water and beach pollution, and other problems.

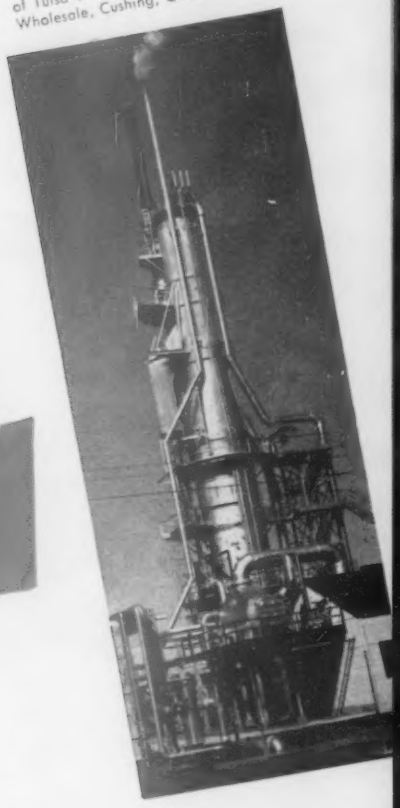
Under terms of the lease, the group, headed by J. R. (Bill) Pemberton, will pay a flat 18⅔ per cent royalty plus a $25,000 per well bonus. Associated with Pemberton in the venture are Noah Dietrich, David Thayer, James Giardetto, and Carlyle Lynton.

Reactor-regenerator for UOP Catalytic Cracking Unit furnished through Refining Engineering Co. of Tulsa for Kanotex Refining Company, Arkansas City, Kansas.

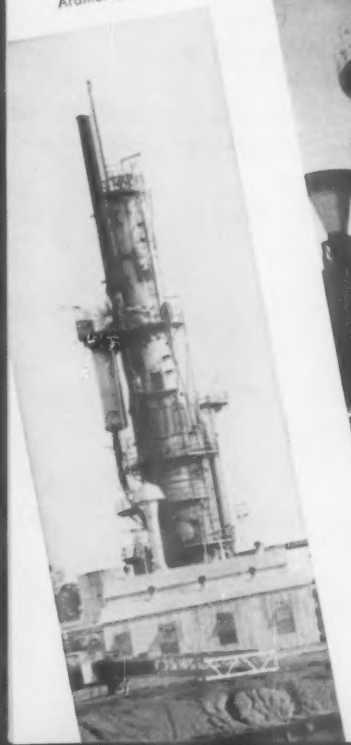
Reactor-regenerator and two cat hoppers built for Rock Island Refining Company at Zionsville, Ind.

REFINERY BEAUTY

UOP reactor-regenerator built for the Refining Engineering Company of Tulsa at Midland Cooperative Wholesale, Cushing, Oklahoma.



UOP reactor-regenerator unit furnished for the Ben Franklin Refining Co., Ardmore, Oklahoma.



Regenerator, part of a Model IV Catalytic Cracking Unit, furnished through Fluor Corporation Ltd. for Standard Oil Company of California, El Segundo, California.

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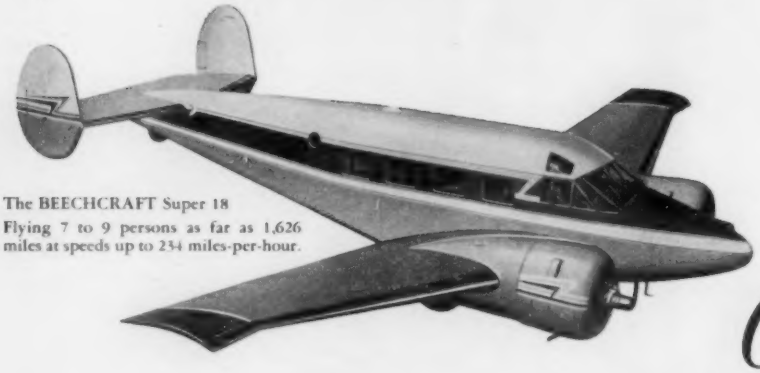

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Flying 6 persons as far as 1,650 miles at speeds up to 240 miles-per-hour.

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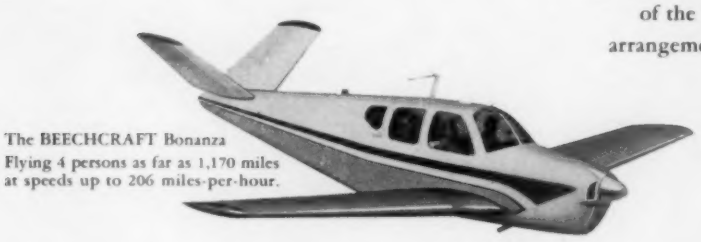

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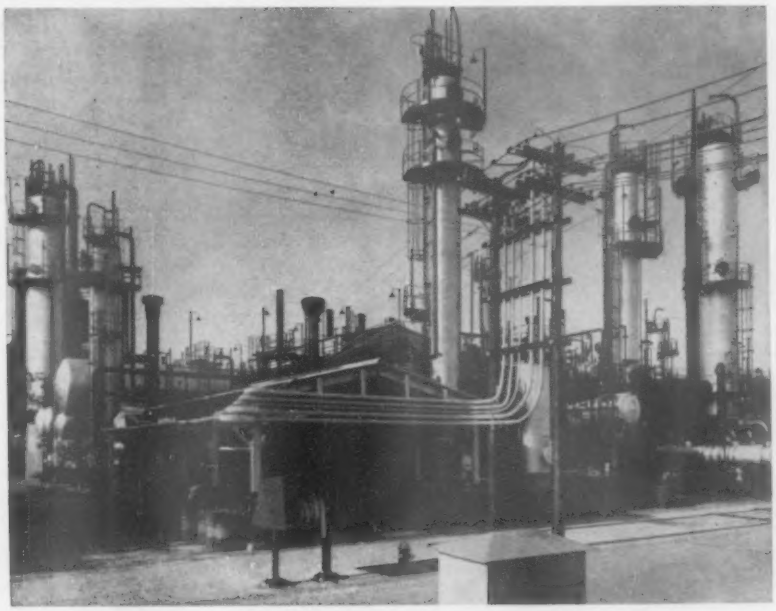


First Gulfiners Go on Stream

PORT ARTHUR, Tex. — The first two processing units using Gulf Oil Corp.'s new Gulfining technique have gone into operation at the company's sprawling Port Arthur refinery.

A new process developed by the company, Gulfining is used to produce a higher-quality home-heating fuel. Oil to be treated in the process is heated to 700°-800° F., mixed with hydrogen at the same temperature, and passed over a catalyst. Sulfur content of the oil is greatly reduced in the process and the oil is stabilized and otherwise upgraded to make it clean-burning, Gulf explained.

Hydrogen used in treating the oil is a byproduct of recently installed catalytic reforming facilities. Sulfur is removed in the form of hydrogen sulfide and recovered as elemental sulfur in another unit.

The two Gulfining units have a combined capacity of 45,000 bbl. daily. They were constructed by M. W. Kellogg Co.

Tidelands Case Appealed

● **California attorney goes to State Supreme Court in an attempt to halt "wildcat" classification of tidelands areas**

LOS ANGELES.—An old foe of California's State Lands Commission was back on the firing lines after a recent setback at the hands of the District Court of Appeals.

Los Angeles Attorney Phill Silver last week filed an appeal with the State Supreme Court asking them to reverse a lower court decision denying him a writ of mandamus aimed at halting certain tideland classification methods used by the commission.

The case, rapidly taking on a "who's on first?" appearance, started last October with Silver's original petition for the writ of mandamus.

At the time the attorney charged the commission was not doing right by the state in the matter of classifying the recently opened tidelands as either wild or on a known structure.

Specifically, Silver alleged the commission's requirement of an actual producing well before taking a parcel out of the wildcat category was ridiculous and would automatically make all tidelands wildcat areas. The result would be tremendous losses in royalties to the state, he said.

He also asked the court to vacate a commission determination that a 5,600-acre parcel of the Los Angeles-Ventura County line is in a wildcat area. Bids on this parcel will be opened January 18. It was originally requested by Superior Oil Co.

Silver further asked that the commission be restrained from making any further offshore classifications without use of geophysical information. The Supreme Court referred the petition to the District Court of Appeals which denied it without comment last month.

The law . . . Under terms of the Cunningham-Shell Act of 1955 which opened up the bulk of the state's tidelands to exploration and development, wildcat parcel leases have a flat 12½ per cent royalty provision. "Known structure" classified parcel leases have an escalator clause beginning at a minimum of 16⅔ per cent.

An indication of how highly oil companies prize some of the state's offshore lands was seen recently when a 5,500-acre parcel off Summerland drew a top bid of $7,250,606 from Standard Oil Co. of California and Humble Oil & Refining Co. acting jointly.

The first offshore parcel put up for bonus bidding under the Cunningham-Shell Act was a 500-acre parcel, also at Summerland, which was classified as on the structure of a producing oil field. It went to Tidewater Oil Co. last summer for $75,000.

Drilexco Expanding

U.S. firm will step up its foreign-drilling operations

PLANS for early expansion of its contract drilling operations abroad have been announced by Drilling & Exploration Co., Inc.

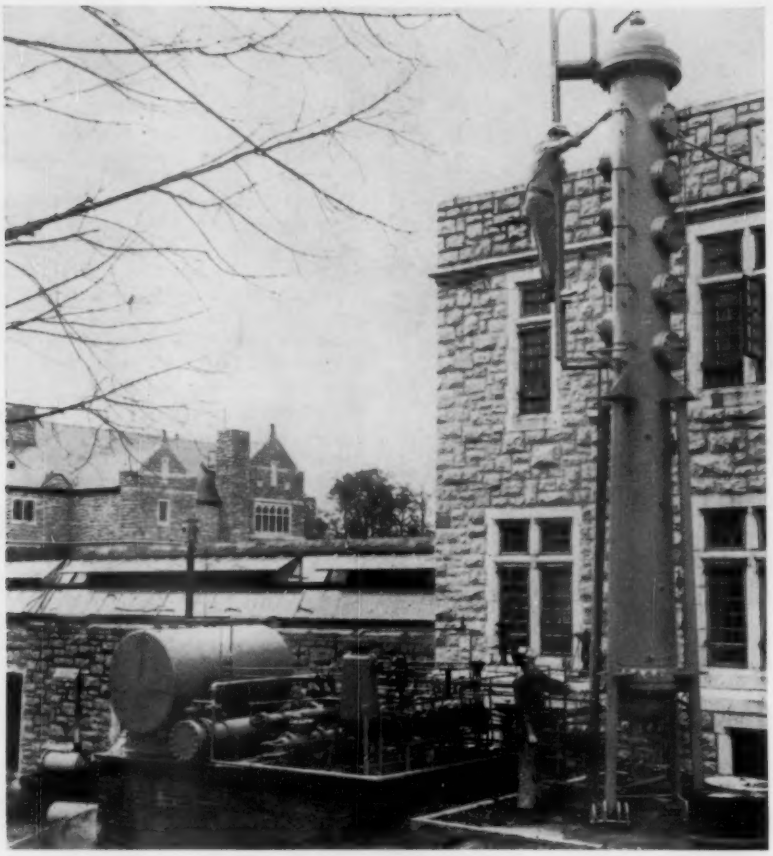
The company recently put one rig to work in Turkey and soon will add a second rig in that country. Plans also are under way for moving a rig into Pakistan. This would be operated by a Dutch subsidiary, Drilvo, in which Drilexco owns 51 per cent interest.

The Dutch subsidiary now has rigs under contract to major oil companies in Holland, France, Sicily, and Nigeria.

Through wholly owned subsidiaries, Drilexco has been drilling in Brazil, Iran, and Oman. The company now has a contract to operate 20 government-owned rigs for Petrobras in Brazil.

"There is every indication that the tempo of foreign drilling will increase in the period immediately ahead," said C. R. Rider, chairman and president of Drilexco, in a statement to stockholders. "It is anticipated, therefore, that the company's contract drilling operations outside the United States may be substantially expanded."

A domestic subsidiary operates 18 rigs in the United States and soon will add its first barge rig for drilling in shallow waters of South Louisiana.



Campus "Refinery" on Stream

BLACKSBURG, Va.—A "crude distillation unit" has gone on stream here, but it doesn't figure to worry any refiners much from the standpoint of competition.

Reminiscent of the days when the oil derrick was likely to appear anywhere, this one has gone up among the buildings of Virginia Polytechnic Institute, which has a student body about the size of the crew needed to operate a big refinery.

A surplus distillation tower was donated to the land-grant college by Esso Standard Oil Co. The tower and auxiliary equipment came from Esso's Baltimore and Baton Rouge refineries, where they gave way to more modern installations.

Students themselves erected the tower and installed the control panel inside the nearby chemical engineering building. It is currently being used to fractionate out a solvent grade hexane from a catalytic reforming feed stock.

The unit will later be used for splitting other petroleum fractions, aid in research, and offer on-the-job employment to students in the chemical engineering department. But more important, it will give them practical experience in refining.

Stanolind Tries New System

AUSTIN.—Stanolind Oil & Gas Co. hopes soon to have its new automatic custody transfer system installed on two company leases in Texas. Requests have been filed with the Texas Railroad Commission.

Stanolind plans to install the automatic equipment on its Fannie Drake Lease 02017 in the Hastings field and on its C. S. Dean "A" lease in Slaughter and Levelland fields. Hastings field is in Brazoria County on the Texas Gulf Coast, while Slaughter and Levelland are in West Texas in Cochran and Hockley counties.

Stanolind has already tested the new system in the field in the Southwest Sholem Alechem pool, Carter County, Oklahoma *(The Oil and Gas Journal, November 26, 1956, page 52)*. The system has just two principal components, an elevated storage tank and a smaller metering tank.

Industry briefs

A nuclear-powered submarine tanker rated at 30,000 tons and 22 knots is on the drawing boards in Japan. Mitsubishi Heavy Industries Co. plans to build it.

The radically new vessel, equipped with a snorkel-type air intake and exhaust, would be capable of cruising underwater for more than a month at a time, avoiding turbulent surface conditions which often hamper shipping in the Pacific. The submarine would be 540 ft. long and have a 69-ft. beam. It would be ten times the weight of the Nautilus, the first atomic submarine in Uncle Sam's fighting fleet.

The Armed Services Petroleum Purchasing Agency last week became the Military Petroleum Supply Agency as control was formally shifted to Navy Secretary Charles S. Thomas. It will carry on with its old duties and handle additional jobs of procurement inspection, cataloging, contracting for commercial fuel storage, and operation of government-owned fuel facilities.

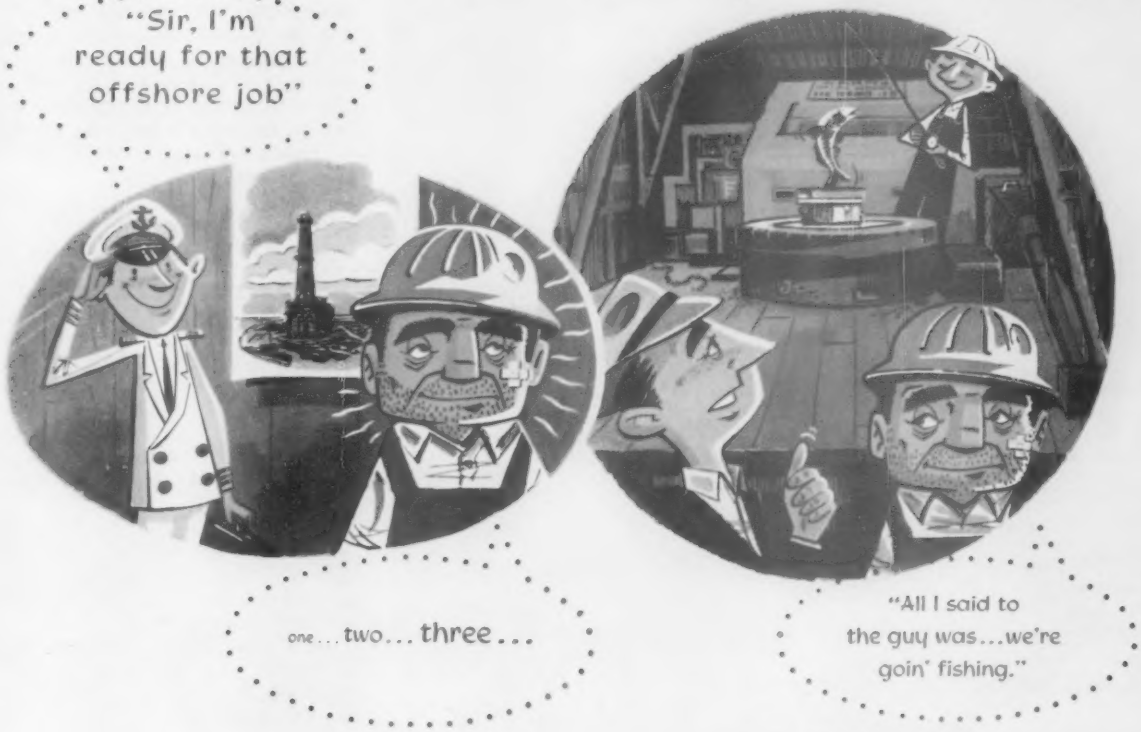
Imperial Oil Co., Ltd., will spend more in 1957 than its total of $115,000,000 in 1956, according to W. O. Twaits, executive vice president. Its '57 expenditures are dependent on the availability of materials. It plans to increase its refining capacity, entirely through expansion of existing facilities.

Canada's demand for crude oil is expected to reach 770,000 bbl. per day in 1957, up 7 per cent from 1956, Twaits said. The country's crude production last year averaged 478,000 bbl. per day and is expected to go to 530,000 bbl. this year. Imperial's production averaged 118,000 bbl. per day in 1956 and compared with total refinery runs of 290,000 bbl. per day. About 67 per cent of Imperial's crude runs is Canadian production.

Standard Oil Co. of California will spend $400,000,000 in the Western Hemisphere this year — $35,000,000 more than 1956 expenditures. Exploration and development will take $250,000,000 of the total. More than three-fourths of this will be spent in the U. S. About $66,000,000 will be used to expand and improve refining and chemical manufacturing facilities. This is double the 1956 amount.

The Texas Co. has been granted city permits for constructing a $3.5 million, 12-story office building on fashionable Wilshire Boulevard in Los Angeles. The building will house the company's western operations now spread out in downtown Los Angeles offices.

Win $25.. write a Joe Roughneck cartoon line



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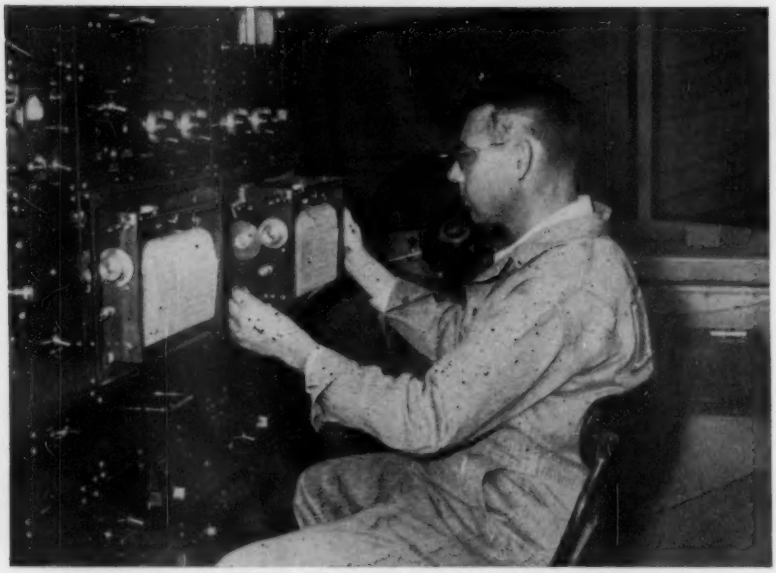
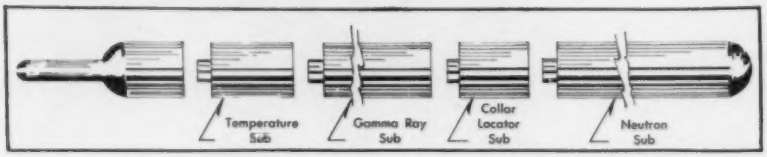


LOGGING COSTS are shaved with the new package well survey, introduced by Worth Well Surveys, Inc. Dual records in instrument truck (above) enable operator to obtain six logs in one run into the hole. The tool is actually a four-in-one device (below).



New down-hole tool means . . .

. . . Six Logs in a Single Trip

FORT WORTH, Tex.—A new package-type well survey, introduced here last week, is expected to cut operators' logging costs.

It obtains in one run into the hole data which formerly required two and sometimes three runs. The new set-up employs a multisection down-hole tool which feeds signals to independent dual recorders in the instrument truck at the surface.

In one trip, it produces these six logs:

. . . **Temperature.**

. . . **Regular gamma ray** (2 in. per 100 ft.).

. . . **Detailed gamma ray** (5 in. per 100 ft.).

. . . **Regular neutron** (2 in. per 100 ft.).

. . . **Detailed neutron** (5 in. per 100 ft.).

. . . **Casing collar.**

Common practice in the past has been to make two runs into the hole to get the regular and detailed gamma ray and neutron logs. A temperature log to show top of cement is usually run by itself too.

Worth Well Surveys, Inc., which introduced the new package survey, points out that its use will save the operator two service charges and a considerable amount of rig time. Another advantage is that the radioactive logs can be examined in less haste than ordinarily when rig time is involved.

The temperature survey, Worth Well Surveys claims, is so sensitive that it will show cement tops without difficulty 60 to 75 hours after the plug is down. Normally the temperature survey must be run within 24 hours.

Only requirements are that the float collar must be set below the prospective producing zones and care should be taken to prevent cement from washing up on top of the plug.

The package survey's new dual recorders were designed and built by Westronics, Inc., Fort Worth.

Suppliers Face Good Year

WASHINGTON.—A 15 per cent increase in sales of oil-field equipment and machinery is forecast for 1957 by the Commerce Department.

Commerce Sec. Sinclair Weeks pointed to a substantial gain in the number of wells to be drilled in the next 6 months over the corresponding period in 1956. He said contributing factors would be increased crude exports due to the Middle East situation, resumption of drilling activity which was postponed last year because of the steel strike, and normal increase in domestic demand for products.

Weeks also foresaw a slight increase in the tonnage of tankers under contract in U.S. shipyards. This will result, he said, from a saturation of foreign shipments, a world-wide shortage of shipbuilding steel, and the high interest in tankers.

Refinery Contracted

Kellogg to build Sohio's 60,000-bbl. Toledo plant

TOLEDO.—Standard Oil Co. (Ohio) has awarded M. W. Kellogg Co. the contract for construction of the 60,000-bbl. refinery at Toledo. The plant will cost $34,000,000. Auxiliary offsite facilities will probably raise total investment to $40,000,000.

Sohio's new refinery will replace all present units at Toledo except the 5,900-bbl. alkylation unit which has been operating on feed stock from the Cleveland refinery. New alkylation capacity will be added at Cleveland, and the Toledo unit will switch to local feed stocks when the new plant is completed in April 1958.

The refinery will integrate into a tight processing pattern—atmospheric and vacuum crude distillation, delayed coking, fluid catalytic cracking, hydrogen treating, catalytic polymerization, catalytic reforming, light-ends recovery and stabilization, continuous gasoline blending, and steam generation.

Sohio's capital expenditures for 1956 were budgeted at about $51,000,000. The $40,000,000 Toledo project will be included in 1957 and 1958 budgets, which are expected to remain high. New capital was made available last week by an issue of $25,000,000, 4½ per cent sinking-fund debentures, due January 1, 1982.

Two Gas Plants Scheduled

FORT MORGAN, Colo.—Two new natural-gasoline plants will be built in this area of northeastern Colorado.

Ginther, Warren & Ginther, operator of five other gas plants in the Denver-Julesburg basin, will construct a plant south of here. Exact site has not been selected yet.

Russell Engineering Corp. Houston, will build and operate a plant in the Vallery field east of here. The plant

will be able to handle 2,500,000 cu. ft. of gas daily. It will handle gas from wells shut in for lack of processing facilities. Dry gas will be sold to Colorado Interstate Gas Co. Nine wells are prepared to deliver to the new plant initially.

Another plant is now under construction at Roggen, Colo., by New Drilling Co. It will process 6,000,000 cu. ft. daily from the Roggen, Kiowa Creek, Orchard, and Riverside fields. The dry gas also will be sold to Colorado Interstate.

Pipeliners Convene

Parrish, Connole, Murray will address contractors

BOCA RATON, Fla.—Approximately 750 persons are expected at the ninth annual convention of the Pipe Line Contractors Association which opened at the Boca Raton Hotel and Club January 13.

Principal speakers are J. L. Parrish, chief engineer of Trans-Canada Pipe Lines, Ltd.; William R. Connole, Federal Power Commission; and William J. Murray, chairman of the Texas Railroad Commission.

C. C. Bledsoe of Midwestern Constructors, Inc., president of the association, will make a major address reviewing construction the past year and outlining prospects for the future. He will cover progress in labor relations, safety, contractor-company relations, and new fields of construction which may be open to pipeliners.

A golf tournament starting Sunday, January 13, opened the social events held in connection with the convention.

The program . . . The general business session will start the following day, when Connole's address is scheduled. The first-day program will include a panel discussion on safety, with Roger Pentzien, Pentzien, Inc.; Carl C. Lavern, Houston Contracting Co.; and Bennie G. Pierce, H. C. Price Co., participating.

It will be followed by a water and slurry pipeline panel composed of Fred Culpepper, Ford, Bacon & Davis; Col. F. J. Wilson, Arkansas Basin Authority; David R. Williams, Jr., Williams Brothers Co.; W. A. Swinerton, Engineers Limited Pipeline Co.; and John Henderson, American Gilsonite Co.

Parrish and Murray will address the convention January 15, following a report by the executive secretary. Officers will be elected the same day. Board and closed membership meetings will wind up the convention.

Pipeline briefs

Panhandle Eastern Pipe Line Co. is installing additional compressor units along its main line in Indiana at the Montezuma and Zionsville stations. Dravo Corp. has the contract for 8,000-hp. at Montezuma and Graver Construction Co., Inc., has 6,000 hp. at Zionsville. Completion is due January 31. Dravo has completed a 2,000-hp. unit at Edgerton station.

More gas from Wyoming's Big Piney field is being sold to the Pacific Northwest Pipe Line Corp. for transmission to the Pacific Northwest. Big Piney Oil & Uranium Co. is turning 8,000,000 cu. ft. daily from three wells into the big line which runs from the long-neglected field began ton. First commercial gas production from the field began in August, after 18 years with no outlet.

Ohio Fuel Gas Co. plans this year to develop an underground storage project with capacity of 10½ billion cubic feet in a depleted field in Vinton County, Ohio. The company is seeking Federal Power Commission authority to drill 90 storage wells, convert six old producing wells to storage, lay 15 miles of pipeline, and build a compressor station.

Trans Mountain Oil Pipe Line Co. expects to increase deliveries to Vancouver and the United States West Coast by 20,000 bbl. daily during January. Throughput through the crude line during December averaged 155,000 bbl. daily. This is expected to be stepped up to 175,000 this month.

The expanded operations will be made possible in part by completion early this month of the first unit of a permanent pump station at Jasper, Alta. Trans Mountain has been increasing capacity of its system steadily to keep up with rising demand for crude in the Pacific Northwest. Capacity is scheduled to reach 240,000 bbl. daily in August.

Interstate Oil Pipe Line Co. has sold its crude gathering system in Wayne, Jasper, and Clark counties, Mississippi, to Trans-State Pipe Line Co. Trans-State will take over operation of the 134 miles of 2 to 12-in. lines serving Heidelberg, Eucutta, Yellow Creek, and North Yellow Creek fields.

El Paso Natural Gas Co. is laying 338 miles of 34-in. pipeline from the San Juan and Permian basins to the California border. R. H. Fulton & Co. has the contract for 102 miles and Western Pipe Line, Inc., is building 144 miles. El Paso Natural's own spread is handling 92 miles of the construction, which is due for completion in April. The company still has not contracted its 1957 program of 888 miles of field and main lines.

R. H. Fulton also has the contract for 241 miles of 30-in. for Southern California Gas Co. and Southern Counties Gas Co. of California, from Newhall, Calif., to Topock, Ariz. This project, will be completed June 30.

Canada's first large-diameter pipe mill goes into production this month when Welland Tubes, Ltd., Welland, Ont., starts turning out 150 miles of 20-in.

The pipe will go to Interprovincial Pipe Line Co., which is extending its crude line from Sarnia to Port Credit, Ont., near Toronto. Production for Trans-Canada Pipe Lines, Ltd., will be next on the mill schedule.

Also for Pipeliners . . .

More Canadian gas—some of it from Alberta's Savanna Creek field—will enter the U. S. as result of a construction program planned by Westcoast Transmission and Pacific Northwest (P. 66) . . . The highly competitive Chicago products market will get another source of supply when Buckeye Pipe Line completes a line planned for the area (P. 76) . . . Pipeline contractors are holding their annual meeting in Boca Raton, Fla. (P. 83) . . . Four pipelines, Atlantic, Southern, Eureka, and National Transit, are joining to move products from Philadelphia to Pittsburgh (P. 84) . . . West Central Texas Oil and Gas Association attacks plan to lay line from Four Corners to southeast New Mexico (P. 84) . . . Construction has started on Shell's natural-gas line from La Paz field to its Cardon, Venezuela, refinery (P. 89) . . . Argentina plans two big crude and one natural-gas line (P. 87).

PLUS THESE TECHNICAL FEATURES: Data telelogging, a new approach to linking the home office with remote-controlled stations. It's trigger-quick and requires a minimum of communication-line facilities (P. 112) . . . and polyethylene tape whips conventional coatings by 3 to 1 margin in long-term test of pipeline wrapping materials (P. 133).

Wildcat Tests Alaska's Kenai

ANCHORAGE.—Alaska's highly regarded Kenai Peninsula will get its first wildcat around March 1. Actual drilling will climax months of geological surveying.

Richfield Oil Corp. originally planned the test for early February. But drilling operations have been delayed pending completion of a 20-mile road from Naptowne to the drill site.

Location will be on a 71,680-acre unitized area in the Kenai National Moose Range. Richfield holds 89 per

cent interest in this Swanson River unit. Union Oil Co. and Ohio Oil Co. divide the remainder. Sunray Mid-Continent Oil Co. is participating in the venture with dry-hole money.

Richfield, as operator on the unit, reports it has no drilling plans for the area beyond the first test. Under terms of the unit agreement, however, a new well must be started within 6 months after completion of the last well.

Preliminary work . . . Selection of a drill site for the first 8,000-ft. wildcat resulted from approximately 2½ months of geological work in the area by Richfield crews.

The nearest previous test of any consequence is Havenstrite Oil Co.'s 9,745-ft. wildcat at Chinitna Bay nearly 100 miles away.

The unit agreement was signed and approved by the Government July 31, 1956. Under the 6-month requirement for starting operations, this meant Richfield would have to start drilling early in February. However, Richfield said it will ask for an extension due to the delay in building the access road.

Richfield has about $200,000 invested in the play thus far. The bill for the road alone will probably be more than $150,000 before it is finished.

Getting ready . . . Despite its remoteness, the Alaskan operation is not expected to pose any unique problems for Richfield.

The rig will be shipped from Los Angeles by coastal steamer to Seward. From there it will be trucked the remaining 100 miles to the drill site. Richfield plans to lay in about a 3-month supply of equipment. In the event of an emergency, supplies can be flown in to the small town of Kenai, 40 miles from the drill site. Kenai is serviced daily by Pacific Northwest Air Lines.

Pipelines Linked

Four systems will carry products for first time

PHILADELPHIA. — Four pipeline companies are linking parts of their systems to ship products from Philadelphia to Pittsburgh.

The new system will begin operations January 15, with initial capacity of 7,500 bbl. daily, with an ultimate expansion to 15,000 bbl.

Atlantic Pipe Line Co. has installed a pumping station at Brookhaven, Pa., where it will tie in with Southern Pipe Line Co. Southern joins Eureka Pipe Line Co., near Morgantown, W. Va.

Eureka ties in with National Transit Co. at Waynesburg, Pa., and National Transit will deliver the products to Neville Island, Pittsburgh.

Southern, Eureka, and National have been operating more than 50 years. They were originally built to carry western Pennsylvania crude to Philadelphia. During World War II they were part of a system carrying southwestern crude to the East Coast.

This is their first use as product carriers.

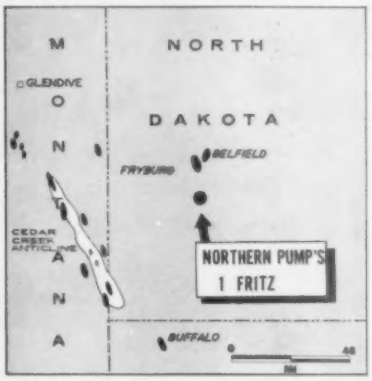
Paradox Pipeline Attacked

ABILENE, Tex.—West Texas independents last week lashed out at Texas-New Mexico Pipe Line Co.'s plan to lay a new 16-in. line which would take Paradox basin crude to Southeast New Mexico for further shipment to Gulf Coast and Mid-Continent refineries.

E. Bruce Street, president of the West Central Texas Oil and Gas Association, condemned the planned line as a development which would deprive West Texas independents of pipeline space and thus market to the Gulf Coast.

Unless new lines are built from West Texas to the Gulf Coast, he said, the Paradox basin oil would inevitably have to displace West Texas oil. This, he said, is because the West Texas-Gulf Coast pipeline system has already been proved inadequate to handle West Texas production.

Street, in a letter to Defense Mobilizer Arthur S. Flemming, said Paradox basin oil should go to the West Coast, not to the east.



New Heath Strike

Williston basin discovery flows 1,200 bbl. per day

BISMARCK, N. D.—Williston basin ended 1956 with one of its best discoveries, Amerada Petroleum Corp.'s 1 Tange, and now appears to have swept into 1957 with another one, Northern Pump Co.'s 1 Fritz in Billings County, North Dakota.

The significant hit, located 12½ miles south of Fryburg field (see map), flowed 50.3 bbl. of oil per hour in 5 hours and 40 minutes on test of the Heath sand (Upper Mississippian) at 8,055-72 ft.

This daily rate of about 1,200 bbl. makes it the most prolific Heath discovery in Williston history, and one of the basin's best wells to date. Flowing pressures were 2,779-3,133 psi.

Big play seen . . . The well is on a Stanolind Oil & Gas Co. farmout in the deeper part of the basin in western North Dakota. Its success should set off a play throughout Slope, Stark, and Billings counties. And the play could spread even wider.

Northern Pump took the well to a total depth of 9,383 ft. after coring in the Charles-Mississippian. No shows were found at that depth.

The only other Heath sand production in the basin is at Fryburg and Belfield in Billings and Stark counties. Amerada's 1 Dan Cheadle brought in 97 bbl. of oil per day from the Heath at Fryburg in March 1954.

GASOLINE KEEPS ITS POWER IN STORAGE WHEN IT CONTAINS

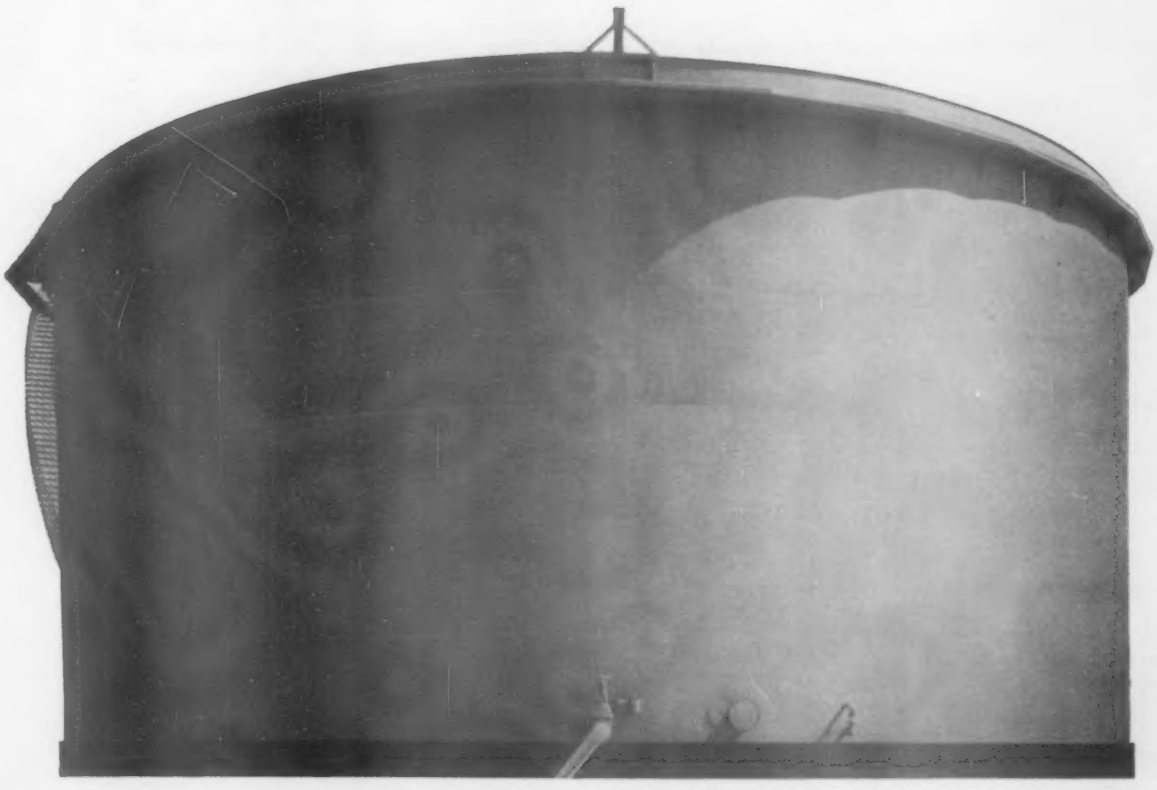
No matter how superior a gasoline you produce, the formation of gums in storage can rob it of its power. To protect the performance of your gasolines—to protect your sales—rely on Tenamene gum-inhibiting additives. Rely, too, on the interested technical service of Eastman petroleum specialists, ready to help solve your refinery inhibitor problems on the spot.

For more information on Tenamene additives and the service that backs up their proper use, contact our local representative or write to EASTMAN CHEMICAL PRODUCTS, INC., *subsidiary of Eastman Kodak Company,* KINGSPORT, TENNESSEE.

Tenamene

EASTMAN GASOLINE ADDITIVES

SALES OFFICES: Eastman Chemical Products, Inc. Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.



U. S. Investments Thriving Abroad

AMERICAN dollars invested in the oil industry outside the United States are doing a better job than the currencies of foreign companies or foreign governments.

The total investment in oil in the free world outside the U. S. at the end of 1955 was $22.9 billion. American companies accounted for just $8 billion or 34.8 per cent of this total. American companies, however, produced 55 per cent of all foreign oil and refined more than 40 per cent of all oil processed outside the United States.

This relationship between investment and output appears in a new study, "Investment Patterns in the World Petroleum Industry," just completed by Frederick G. Coqueron and Joseph E. Pogue of the Chase Manhattan Bank's petroleum department.

While the authors of the study do not say so, the implication is that American efficiency and know-how is the answer.

On a regional basis, the investment-versus-output figures are just as distinctive as they are on a world-wide basis.

American investment accounts for 46.9 per cent of the money sunk into the Middle East's oil industry. American companies handle 55.9 per cent of the oil output. In Canada, American money represents 54.1 per cent of the total invested and U. S. companies account for 69.6 per cent of the output. The same sort of ratio applies to Venezuela where 60.7 per cent of the oil investment is American and 67.6 per cent of the output is handled by U. S. companies.

Growth of capital investments . . . The growth of the world's oil industry has usually been measured in terms of increased demand or consumption of petroleum in the world. Comparing 1946 to 1955, the bank's study revealed that capital expenditures in the industry have shown even a greater growth than oil demand.

The gross investment in fixed assets in the oil industry in the United States was 2.28 times greater at the end of 1955 than it was at the end of 1946. The increase over the same period for the industry outside the U. S. was 3.32 times.

Capital expenditures in the U. S. at the end of 1955 were 2.8 times greater than at the end of 1946. In the free foreign world, they were 3.65 times greater.

Using the same yardstick on production, crude runs to stills, and consumption, the bank found corresponding figures in comparing U. S. and the free foreign world.

U. S. production at the end of 1955 was 1.43 times 1946, but outside the U. S. it was 3.14 times greater. Crude runs to stills were 1.58 times greater in 1955 in the U. S. than in 1946, but in the free foreign world they were 3.14 times greater. Consumption in the U. S. in 1955 was 1.71 times greater than 10 years previous, but in the free foreign world it was 2.76 times greater.

The bank believes the trend in consumption is best illustrated on a yearly basis. The study shows an annual rate

An American Glance at the Free World Oil Industry

Where U. S. Money Is Going

MILLIONS OF DOLLARS

	American companies	Others	Combined	American per cent of area total
Gross investment in fixed assets (year-end):				
Canada	1,365	1,160	2,525	54.1
Venezuela	2,095	1,355	3,450	60.7
Other W. Hemisphere	750	1,690	2,440	30.7
Western Europe	1,045	3,015	4,060	25.7
Africa	100	325	425	23.5
Middle East	1,290	1,460	2,750	46.9
Far East	755	1,195	1,950	38.7
Foreign tankers	575	4,725	5,300	10.8
Total	7,975	14,925	22,900	34.8

THOUSAND BARRELS PER DAY

Crude-oil production:				
Canada	247	108	355	69.6
Venezuela	1,459	699	2,158	67.6
Middle East	1,818	1,432	3,250	55.9
Other countries	249	894	1,143	21.8
Total	3,773	3,133	6,906	54.6
Crude runs to stills:				
Canada and Venezuela	649	421	1,070	60.7
Western Europe	534	1,556	2,090	25.6
Middle East and Africa	520	329	849	61.2
Other countries	751	1,310	2,061	36.4
Total	2,454	3,616	6,070	40.4

Free World Trends Since 1946

MILLIONS OF DOLLARS

	1946	1955	1955 as multiple of 1946
Gross investment in fixed assets (year-end):			
United States	17,700	40,400	2.28
Free foreign	6,900	22,900	3.32
Total	24,600	63,300	2.57
Capital expenditures:			
United States	2,000	5,600	2.80
Free foreign	725	2,645	3.65
Total	2,725	8,245	3.03

THOUSAND BARRELS PER DAY

Crude-oil production:			
United States	4,751	6,807	1.43
Free foreign	2,198	6,906	3.14
Total	6,949	13,713	1.97
Crude runs to stills:			
United States	4,740	7,480	1.58
Free foreign	2,043	6,070	2.97
Total	6,783	13,550	2.00
Petroleum consumption:			
United States	4,912	8,415	1.71
Free foreign	2,179	6,018	2.76
Total	7,091	14,433	2.04

of increase compounded for the U. S. at 5.8 per cent. The increase for the free foreign world has been 11.0 per cent. In the same type of comparison, capital expenditures for the years 1947-1955 for the U. S. indicates a growth of 8.9 per cent and 10.1 per cent for the areas outside the U. S.

Comparative demand patterns . . . The contrast between the demand patterns of the U. S. and the free world outside this country is very marked.

The emphasis in the U. S. is on gasoline and this trend has shown some growth between 1946 and 1955 with a corresponding drop in the use of residual fuel oil. In the rest of the free world, the "more gasoline" trend is reversed. It is only in the use of middle distillates that the entire world's gain has been more or less uniform.

In 1946, gasoline represented 41 per cent of all petroleum consumed. In the rest of the world it was 28.1 per cent. By the end of 1955, this percentage had risen to 43 per cent in the U. S., but had dropped to 25 per cent in the rest of the world.

In the same period, residual fuel oil dropped from 26.8 per cent to 18.2 per cent in the U. S. The rest of the world showed a drop of only 0.5 per cent in the same period—from 38.4 per cent to 37.9 per cent.

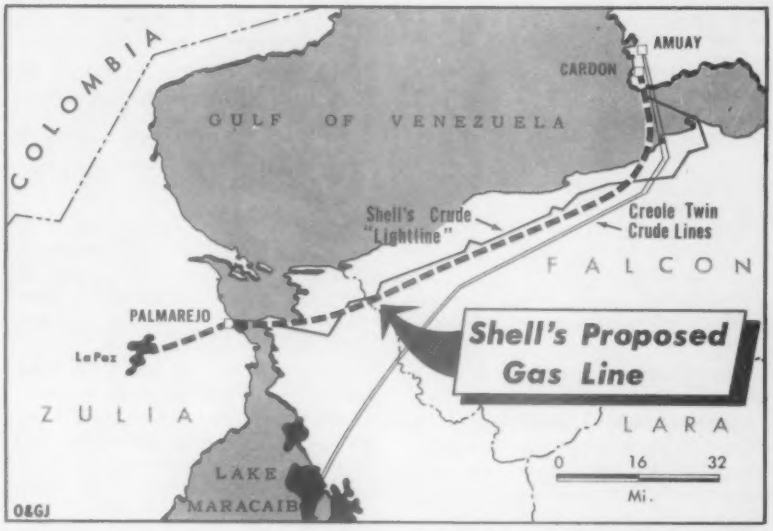
Comparing those 2 years for middle distillate consumption figures, the bank found that in the U. S. middle distillates accounted for 18.5 per cent of demand in 1946 and 22.7 per cent in 1955. Outside this country the increase in this demand followed just about the same pattern, from 22.7 per cent in 1946 to 25.4 per cent in 1955.

Basrah Hits Export Goal

Basrah Petroleum Co., the affiliate firm of Iraq Petroleum Co., announced last week it made its export goal of 59,360,000 bbl. of crude in 1956. This amounts to about 162,600 bbl. daily.

The company, which operates Zubair and Rumaila fields in southern Iraq, actually reached this rate of production by the beginning of 1956, meeting the terms of its 1951 profit-sharing arrangement with the Iraq Government. The Suez Canal crisis and the resulting tanker shortage, with delays in tanker liftings at Fao, made reaching the goal for 1956 an accomplishment.

Because Fao can handle only shallow-draft tankers, the northern Persian Gulf port is hard-pressed to expand its crude exports. Basrah Petroleum, however, has increased its production steadily and the 1956 production figure is almost double the company's output only 2 years ago.



Work Starts on Venezuelan Line

CONSTRUCTION was started last week on the overland phase of a 177-mile, 20-in. natural-gas pipeline being built by Cia. Shell de Venezuela.

Williams Brothers Co., world-wide pipeline construction firm of Tulsa, has the contract for the line from La Paz field, in the Maracaibo district, to Shell's 245,000-bbl. refinery at Cardon, largest in Venezuela.

The line will transport 106,000,000 cu. ft. of gas daily to fire refinery boilers, freeing additional fuel oil to fulfill export commitments to Great Britain. The project, to cost an estimated $21 million, will be completed some time this year.

The lake and gulf crossings, contracted to Brown & Root, Inc., Houston, were started last year and have already been completed.

The Shell project is one of three major pipelines now under construction in Venezuela. Williams Brothers also has the contract for a 212.5-mile, 20-in. crude line from the Barinas-Apure basin to Puerto Cabello, to be completed in July *(The Oil and Gas Journal, November 12, 1956, page 141)*.

The government is building a 207-mile, 26-in. natural-gas line from Anaco, Eastern Venezuela, to Caracas, with construction being handled by Petrogas, S.A., and Fulghum Contracting Corp., Harrisburg, Pa. *(The Oil and Gas Journal, December 24, 1956, page 54)*.

Bids Sought for Big Argentine Lines

ARGENTINA is moving forward with plans for a major pipeline construction program involving expenditure of $119 million.

Bids are being taken by Yacimientos Petroliferos Fiscales (Y.P.F.), the government oil agency, on the following projects:

. . . A 932-mile crude line from Campo Duran to San Lorenzo, with capacity of 58,000 bbl. daily. The 12-in. line will cost $24 million. A 90-mile section of the line has already been contracted to Techint, an Italian construction firm.

. . . A 1,056-mile natural-gas line from Campo Duran to Buenos Aires, with capacity of 247,000,000 cu. ft. per day. Estimated cost is $46 million.

. . . A 497-mile crude line from Mendoza to Buenos Aires, with capacity of 40,000 bbl. per day. Estimated cost is $19 million.

Diadema Argentina (Royal Dutch-Shell) has a refinery at Buenos Aires and Y.P.F. has a refinery at San Lorenzo. Y.P.F. has been negotiating in the United States and Europe for some $250 million in loans to finance expansion in production, transportation, and refining.

The government has not disclosed what progress it has made toward firming up the over-all program. Bids on the pipeline projects will be opened March 29 in Buenos Aires, New York, and Duesseldorf. The date for starting construction has not been announced.

Suez Activity Picks Up

● Ships caught in canal by hostilities move out; Egyptians threaten to bar British-French ships when canal reopens and Syrians still holding up repairs on I.P.C. pipeline

THE first really concrete moves toward restoring Middle East oil supply lines to normal were going ahead last week, but purely political complications continued to plague the area on two fronts.

Here are the latest developments and the political complications of each:

. . . Suez Canal clearance is moving ahead with the United Nations experts now predicting that some sort of a channel through the entire length of the waterway may be cleared by May.

Thirteen ships, including the Cities Service tanker, Statue of Liberty, began moving northward out of the canal last week. The vessels have been trapped in the canal since a southbound convoy from Port Said was caught 7 miles north of Ismailia October 31.

The Egyptians ignored U.N. authorities in the canal zone last week and began turning the vessels around in the canal for the trip to the North. The Egyptians insist that the U.N. can help clear the canal, but they are going to handle any operations of the waterway. This was their way of emphasizing the stand.

. . . Barring of British and French vessels from the canal once it is reopened will apparently be the Egyptians' next move. This is the political complication.

Cairo radio last week said that no British or French shipping would be allowed to move through the canal until Israeli forces evacuate both the Sinai Peninsula and the Gaza strip.

This brought an immediate protest from the British Foreign Office in London. The British insist they left Egypt after receiving assurances from Nasser's Government, through the U.N., that there would be no interference with British and French canal traffic.

Britain and France together control about 23 per cent of the total tanker tonnage in the world. If these vessels are successfully barred from the canal, there will be a crimp in world oil movements with the canal restored to full use.

. . . Pipeline damage inspection teams from Iraq Petroleum Co., Ltd., have finally been allowed to enter Syria to look over the pump station damage that shut off the flow of more than 550,000 bbl. of Iraq oil daily. Here again there is a political complication.

About 35 Iraq Petroleum engineers were allowed to inspect the three damaged pipeline pump stations just as the new year opened. The inspection teams entered Syria under police escort as a result of talks between Salah Bitar, Syrian foreign minister, and Geoffrey Herridge, an I.P.C. director.

Bitar made it very clear, however, that no work would be done on repairing the damage or in bypassing the stations with temporary flow lines until the last Israeli troops are out of territory claimed by Egypt.

The Syrian foreign minister also made it very clear that his country has no intention of meeting British demands that Syria pay for the damage done to the pipeline system. Bitar said Syria accepts no responsibility for the safety of the pipeline system and added that it was blown up as a Syrian defense measure and "as a legitimate reaction to the Port Said aggression last fall."

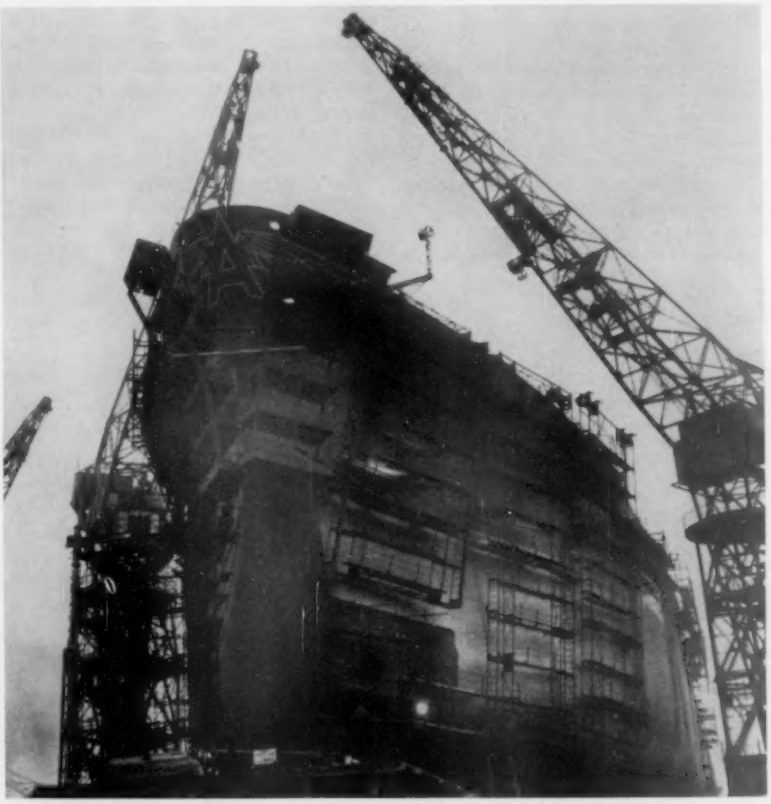
Tanker rates ease . . . There was every indication in this country last week that more vessels available for spot tanker charters may be diverted to the Persian Gulf-to-Europe trip.

It is purely a matter of dollars and cents. Rates being paid for spot voyages from the Caribbean to the U. S. East Coast and to Europe have begun to soften. This would indicate the shorter voyage and shorter turn-around time involved in the Caribbean trade attracted more tankers than are urgently needed.

Spot tanker rates of $8.25 a ton that were paid late in December for the Caribbean - East Coast voyage had dropped to less than $6.70 a ton last week. Every indication is that they may soften even more.

The same sort of rate paid for the Caribbean - to - Europe voyage had dropped from about $19.30 to about $15.90 in the same period.

If this trend continues, more tanker owners are almost certain to look for the Persian Gulf - to - Europe charters because those rates have shown all indications of remaining at peak levels.



WHILE THE SUEZ CANAL is being cleared, supertankers that will be too big to use it are sliding down ways throughout the world. Here the 52,680-ton Minnehoma is being prepared for launching at Dunkirk, France. The tanker will be chartered by Tidewater Oil Co. It is being built for Hemisphere Transportation Corp. of America.

Turk Project Set

Work will begin soon on NATO pipeline facilities

WILLIAMS Brothers of Tulsa and Costain-John Brown, Ltd., London, will start construction this spring of 28 pump stations and tank farms on the NATO products pipeline system in Turkey.

Completion of the $15-million project is scheduled for the summer of 1958. The products system, now under construction, includes 915 miles of various-diameter lines from Iskenderun to Batman, from Bandirma to Eskisehir, and from Antalya to Eskisehir.

The contractors have already set up headquarters in Ankara. Eighteen of the 57 Spartan trailer units which will house construction crews were delivered in Tulsa recently for shipment to Turkey. Delivery of the others will be completed by April.

Williams Brothers normally uses prefabricated aluminum huts which can be dismantled on its pipeline spreads. Trailers appeared more suitable for this project because of the flexibility needed in building the widely scattered stations. They were designed by the contractor.

There will be 13 Americans, 70 Britons, and 800 Turks on the project. F. J. Woodsmall will be project manager; L. C. Meader, chief engineer; and H. W. (Buddy) Franks, general superintendent.

Sicilian Output Will Double

Sicily's oil production will be stepped up sharply in the near future when Gulf Italia puts its new 43-mile, 14-in. pipeline from Ragusa field to Augusta in operation.

Ragusa field output is expected to average about 20,000 bbl. daily with the pipeline in operation. The company now has 14 wells in the field, but production has been held to the 10,000 bbl. daily level, or less, awaiting a pipeline outlet.

Ceylon Refinery Still Alive

Ceylon's Government is again considering a proposed refinery for the island.

Four companies have sent representatives to inspect possible sites at Trincomalee, Galle, and Negombo. The firms are British Petroleum Co., Ltd., Royal Dutch-Shell, Caltex, and Standard-Vacuum Oil Co., Inc. Bids will be made after the surveys are completed.

At least one independent company was invited by the government to make an offer. Russia also has shown an interest in the project.

The refinery has been a hot and cold subject in Ceylon for more than 2 years. A four-company proposal by B. P., Shell, Caltex, and Stanvac needed only formal approval when a new government administration turned it down earlier this year.

Spain Tests System

First products enter line linking U. S. air-base net

THE first test shipment has entered the 485-mile military products pipeline system in Spain.

Forty-two thousand barrels of diesel oil was unloaded recently from a tanker into underground storage at Rota, the southwestern terminal of the network on the Atlantic Coast near Cadiz. This batch is now en route to Zaragoza, in northeastern Spain.

Tests on the $41,000,000 network are expected to last 4 months. The line will then link a $300,000,000 system of United States air and naval bases in Spain.

The line has a 12-in. diameter for 135 miles, where it passes the first two of the five air bases it will supply. It then reduces to 10-in. and 8-in.

Three tank farms along the route have a total capacity of 6,000,000 bbl. Tanks are covered by 6 ft. of protective concrete. The line itself lies 3 ft. underground.

Prime contractor for the project was a group composed of Brown & Root, Inc., Houston; Raymond Concrete Pile Co., New York; and Walsh Construction Co., Davenport, Iowa.

Work began in October 1955. The construction contract called for completion in 425 days.

Brazil Dedicates Refinery

The 5,000-bbl. refinery at Manaus in the Amazon jungles of Brazil was officially dedicated last week by President Juscelino Kubitschek.

The plant, built for Cia. de Petroleo da Amazonia by Southwestern Engineering Co., Los Angeles, has been undergoing test runs for months. It actually began processing Venezuelan crude some time ago.

In addition to Venezuelan crude, the plant is expected to run about 2,500 bbl. daily of crude from Agua Caliente field, operated in eastern Peru by Ganzo Azul Cia. de Petroleo. The Peruvian crude will be barged down the Ucayali River to the Amazon and then to Manuas, a trip of about 1,800 miles *(The Oil and Gas Journal, May 30, 1956, page 102)*.

World briefs

International Egyptian Oil Co. has taken over two large rigs in Egypt from Camdrill International, Inc., under a "force majeure" clause of a drilling contract.

Camdrill, a subsidiary of Southern California Petroleum Corp. of Los Angeles, said it has received full payment for the rigs and described the deal as "a satisfactory one."

Fish Service de Mexico, subsidiary of Fish Service Corp., Houston is building a $3.5 million Frasch-process sulfur plant for Central Minera, S.A., in Mexico. The plant will have capacity of about 1,000 tons daily.

Fish is now completing geological and engineering studies of the sulfur deposits on the 123,000-acre concession in the Isthmus of Tehuantepec held by Central Minera. Fish in addition to building the plant will train management personnel and maintain control of the operation. Central Minera is a subsidiary of Texas International Sulphur Co.

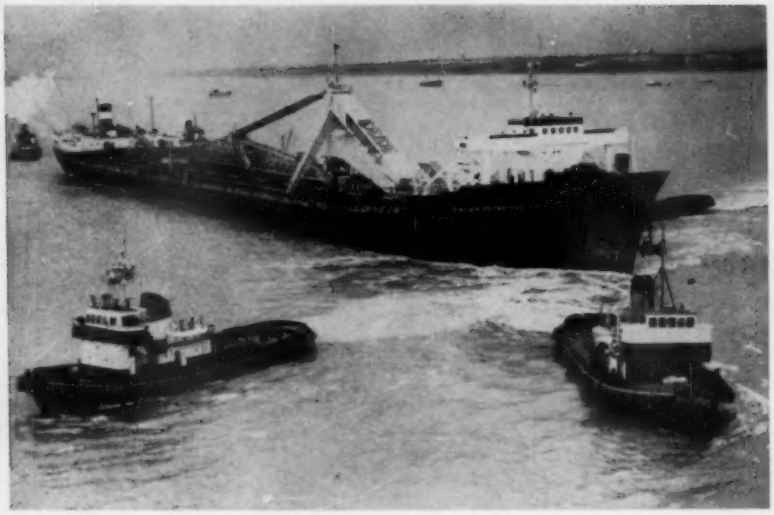
Phillips Petroleum Co. has licensed its catalytic process for making rigid polyethylene to a Brazilian firm, Industrias Quimicas Eletro Cloro, S.A. The firm is a subsidiary of Solvay & Cie. of Brussels, which previously also held the Phillips license for use in Italy.

Phillips is now starting operation of the first unit of a 110-million pound a year plant for producing the new polyethylene at its Adams Terminal chemical manufacturing site on the Houston ship channel.

A new ammonia plant for Japan's growing heavy chemicals industry will be designed by Chemical Construction Co., New York. Asahi Chemical Industry Co., Ltd., will build and operate the plant. It will use the Texaco oil gasification process.

Asahi is Japan's largest manufacturer of synthetic fibers and explosives. It will use ammonia from the new plant to make rayon, fertilizers, plastics, and explosives.

Italy's fourth U.O.P. Platforming unit has gone on steam at the Industrie Chimiche Italiano del Petrolio refinery at Mantova. The new 2,300-bbl. daily unit produces a 90-92-octane, debutanized platformate from a Kuwait naphtha charging stock. The refinery now can produce premium gasoline having a 98-100 leaded octane rating.



Big Shipment Eases A Big Shortage

ENGLAND became more than 375,000 bbl. of crude richer late last month as the former record-holding "Sinclair Petrolore" tied up at Fawley refinery in Southampton with a sorely needed cargo from Kuwait.

Rated at 56,089 tons, it was the biggest tanker ever to dock in England and one of the first to be diverted to that country under America's emergency plan to move oil to Europe after closure of the Suez Canal.

When the "Sinclair Petrolore" was launched in July 1955 at Kure, Japan, it was the world's largest tanker. Built for Universe Tankship, Inc., it was chartered under the U. S. flag by Sinclair Refining Co. for 8 years.

The tanker was assigned to transport crude from Kuwait around the Cape of Good Hope to Sinclair's 102,000-bbl. refinery at Marcus Hook, Pa. The first major ship designed to carry both liquid and dry bulk cargoes, it transported iron ore from Venezuela to Japan on its return trip to the Middle East.

Self unloading for both oil and ore cargoes, it has a pumping capacity of 29,600 bbl. an hour. Total crude-carrying capacity is about 447,600 bbl., with room left over for 44,230 bbl. of bunker fuel. The vessel has a speed of 15 knots.

India Field Faces New Setback

SITE of a refinery that would lead to the opening of Nahorkatiya field in Assam, India, probably will not be determined until after elections in March. Thus a minimum delay of another 3 months is expected in the prolonged negotiations between the Indian Government and Assam Oil Co.

Nahorkatiya was discovered in 1953 and a score of wells have been drilled with sufficient potential to supply a refinery of 50,000 bbl. per day capacity. The field has estimated reserves of more than 350,000,000 bbl. Despite the fact that it is almost 4 years old, production is still shut in because of the lack of an outlet.

Control is thoroughly tangled. Assam Oil Co., British-owned, controls two-thirds of the producing company. The Indian Government will dominate the refinery. Assam's minority position in the latter will probably include technical advice.

Complications of control are further compounded by geography. Assam, location of Nahorkatiya field, the 75-year-old Digboi field, and two new fields, Moran and Hugrijan, is in extreme Northeast India. A 6,000-bbl. refinery at Digboi processes the output of Digboi field, supplemented by the production of four Nahorkatiya wells.

Assam is cut off from India proper by the eastern part of Pakistan except for a narrow, 50-mile-wide corridor between Pakistan and Nepal. There are no consuming centers of consequence in Assam so the Digboi refinery is sufficient to meet all the needs of that area. Because of this, Nahorkatiya crude must either be transported outside of Assam for processing or processed there and the products transported to distant markets.

The arguments . . . Assam Oil is reported to favor Calcutta as a site for the refinery. This would necessitate the construction of an 850-mile pipeline at a cost of more than $20,000,000. Local interests reportedly favor building the refinery in Assam, thus saving the cost of the pipeline. However, the problem of getting finished products to market would remain.

Route of the line would presumably follow the Brahmaputra River southwest from the Digboi area for about 400 miles, then swing 100 miles northwest to the Nepal-Pakistan corridor, southwest about 50 miles, and then directly south about 300 miles to Calcutta. This would involve a crossing of the storied Ganges River, not far west of East Pakistan.

If the latest delay does add another 3 months to the negotiations, it means they will have lasted almost 2 years. Meanwhile, not only is Nahorkatiya shut in, but development of the newly discovered Moran field, 25 miles west of Nahorkatiya, and the adjacent Hugrijan field, is held back by lack of outlets.

Holland Ups Output

4,000-bbl. increase to help offset Middle East cutback

CRUDE production in The Netherlands is going to be stepped up more than 4,000 bbl. daily, an increase of 15 per cent, under a program revealed by Nederlandse Aardolie Maatchappij.

Officials of N.A.M. said in Amsterdam that the company can increase its production during the first quarter of next year by 30 per cent, or about 8,500 bbl. daily. This increase would only be for a short term.

The company, jointly owned by Royal Dutch-Shell and Standard Oil Co. (N.J.), is the only producing company in Holland. It accounts for about 25 per cent of the country's oil needs. The Netherlands will average about 20,500 bbl. daily this year and an increase such as the one announced will have a marked effect on improving the country's position in the face of curtailed oil supplies from the Middle East.

New production . . . N.A.M. has made three significant discoveries in the past 2 years.

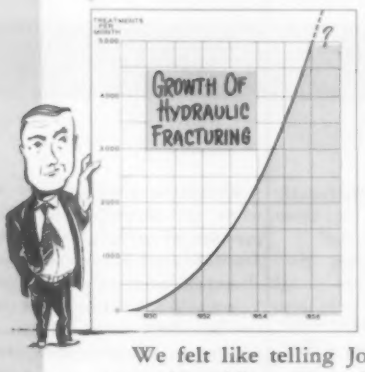
One at Wassenaar went on production this year at more than 600 bbl. daily and 1955 discoveries at Pijnacker, 550 bbl. daily, and De Lier, 170 bbl. daily, are all being produced now. The bulk of the country's output comes from the 13-year-old Schoonebeck field near the West German border.

Why Should I Fracture My Well ?
....and how

Joe's an oil operator, and a good one, too. He's found his share of oil, and not just by luck. He's kept up with new methods and examined all the angles. It's taken a lot of know-how and hard work. But Joe has production.

Joe's wells are all kinds: Some are flowing; others are on pump but have good production; and some are strippers taking the last of the oil out of the reservoir. He'd like for them to make more money so he can spend more on finding new oil.

Joe's been watching oil-field activities all over the country, and thinks that hydraulic fracturing is his answer. It might help his producing wells and perhaps give him more producers out of the ones he's drilling.



"Look at this graph," says Joe. "Fracturing didn't start until 1949 and now it's hitting 5,000 treatments a month. And, as a rough estimate, I'd say that about 20 per cent of all producing wells in the United States have been fractured. It's had a big effect on exploratory thinking. And a lot of guys have been making money fracturing their wells.

"But," Joe continues, " about 25 per cent of these fracture treatments aren't very successful. All wells don't behave the same. I want to be sure of what I'm doing before I start spending money on fracture treatments. Just what are these fractures like and how do they affect a well and the reservoir?"

We felt like telling Joe to go ahead and start fracturing his wells and quit worrying. After all, it doesn't cost too much for a treatment. If everybody's doing it and getting pretty good results, how can you lose? But then we got to thinking that knowing all the angles may not be such a bad idea. Just like in the other phases of the business of finding oil, there may be better ways of doing things. Why not insure best results?

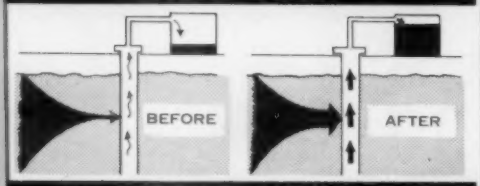
So we put down a lot of questions which we thought oil producers might ask about fracturing. Then we scouted the experts and the people with experience to find how they would answer them. In the following pages you'll find the results. To some questions there may be several answers, depending on how you look at present information. To others, there may be no real answers . . . *yet*. Maybe you will find the answers to help you to make more money out of fracturing.

A SPECIAL FEATURE PRESENTED BY the OIL AND GAS JOURNAL

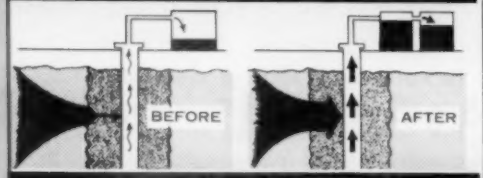
Why Fracture ?

PRODUCTIVITY INCREASES

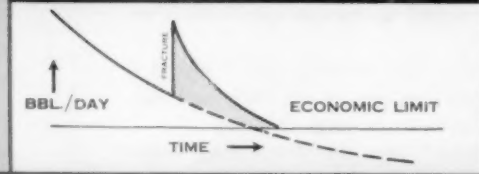
TIGHT ZONE



BLOCKED PERMEABILITY



MORE OIL RECOVERY



1
How can you tell if a well will respond to fracturing treatment?

2
What productivity increases can you expect?

3
Can you expect an increase in ultimate oil recovery?

4
Will there be any difference in results between open-hole or through-perforations?

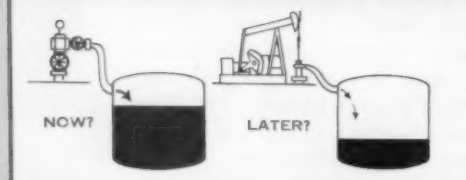
5
Does formation permeability have an influence on fracture results?

1 For a well to produce additional oil as a result of fracturing it must first have oil to produce and then have sufficient reservoir pressure to flow the oil to the fracture. For initial completions, the new "double shut-in pressure" D.S.T. is a good way to determine the capacity of the well to respond. Interpretation of the buildup curve is much the same as for buildup test on producing wells. In old wells, level buildup test or pressure buildup test can determine both the presence of a driving force and the nature of the permeability restriction around the well.

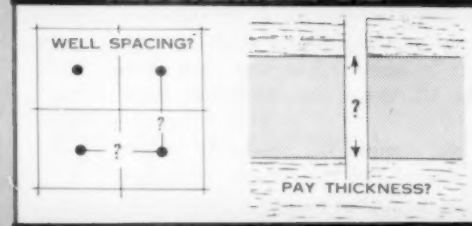
Always suspect wells drilled in tight or dirty formations. These may show little or no production on D.S.T.'s but may be good producers after fracturing. Many times old wells producing from these dirty formations may yield unex-

PAY OUTS

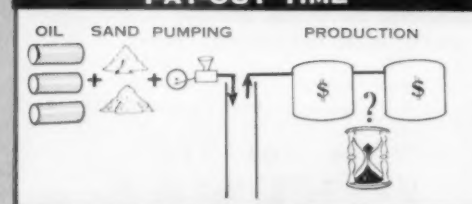
WHEN TO FRACTURE



RECOVERABLE OIL



PAY-OUT TIME



1
During what part of its life should you fracture a well?

2
How much success can you expect from fracturing stripper wells?

3
What thickness of pay zone do you need for success?

4
Why does well spacing affect fracture results?

5
How long will fracture treatments take to pay out?

1 Generally, a well should be fractured while the formation still has sufficient pressure to give good producing rates. Fracturing while the well can make its allowable means a cash outlay too soon. You can't begin to recover it until after the time the well would normally take to decline to the allowable. And the efficiency of recovery is not likely to be affected at this stage. Also, if pressure is too high, you might have to kill the well with water or mud and lose some of the benefit of fracturing.

After a well declines to its allowable rate, the longer you wait to fracture the longer the payout time will be. Fracturing in the early part of the decline will usually allow the well to make more total oil before the economic rate is reached.

2 Although you shouldn't wait to fracture until the well becomes a stripper, fracturing of stripper wells can be quite profitable. Stripper wells have responded

pected oil and pressure because they were partially blocked during drilling.

2 Average increase in well productivity from all fracture treatments has been about 200 to 300 per cent. Exceptions frequently occur because initial productivity is so highly influenced by permeability blocks around the well bore. Fractured new wells sometimes produce several hundred times initial test rate.

Old pumping wells, where reservoir pressure still exists, frequently respond better than the average. Of successful treatments, fracturing has increased productivity about 5 to 10-fold in these wells. Present averages, however, should not be considered final. Greater increases result from longer fractures, where obtainable.

3 Most producers agree that you can produce more oil from a well by fracturing simply because more oil is produced before production rate reaches the economic producing-rate limit. Disregarding economics, it appears that actual ultimate oil recovery can be increased by fracturing, because the flow pattern and drainage pattern are enlarged. If drainage efficiency decreases with distance, putting the drainage surface farther out into the formation allows more oil around the well to drain. Some estimate this increase at about 5 to 15 per cent of the primary recovery.

4 Experience has shown that treatments through perforations are better than open-hole treatments, in most cases. Since the perforations create the condition where any part of a zone might fracture, they increase the chance of opening tight as well as permeable sections.

5 Formation permeability definitely influences production response to fracturing. If permeability around the well bore causes a large pressure drawdown at desirable production rates, the fracturing will help the well. Usually formations of greater than 200 md. do not respond very well to fracturing because the conductivity of the sand-packed fracture doesn't increase total formation conductivity sufficiently to increase oil flow to the well. But if a permeability block around the well is present, even a small treatment will increase productivity to some extent.

Fracturing results are best in lower-permeability formations. The lower limit appears to be about 0.1 to 1.0 md. In very low-permeability formations, high connate water cuts down producible oil. In such formations, productivity will decline rapidly before a substantial part of the reservoir is depleted.

to fracturing in 50 to 75 per cent of the treatments.

If a stripper well is making water in sizable amounts, you should look closely at your pumping costs as affected by produced water. Although rate of oil production might increase appreciably, water will also increase and payout time may be long.

Best chance for payout from stripper wells is from fairly tight formations. Many times some pressure is found in the formation. The more permeable sections may be depleted, but you may get added oil from opening up the tight sections. Loose formations respond poorly. There may be high initial production but rapid decline. And unless there is sufficient drainage toward the well, you may lose your load oil.

3 About 5 ft. of pay is usually considered the minimum. But any thickness figure is only a way of expressing recoverable oil. Increase of production rate isn't dependent on thickness, necessarily, but ultimate recovery and payout of the treatment are.

If you are looking at thin zones, consider previous production and possible future recovery. For instance, a 10-acre area of a 5-ft. sand may not at best produce more than 8,000 bbl. of oil during the entire primary production.

Where thickness of formation is erratic, the formation wedges out, or all oil-producing sections have not been defined, fracturing of a thin zone may yield unexpected dividends. One notable case on record is a well that had only 4 ft. of sand but produced a total of 150,000 bbl. of oil in response to three fracture treatments.

4 Well spacing enters into payout because it determines the amount of oil that can be produced by any well. The same factors influence the density of well fracturing as well spacing itself. When wells are spaced more closely together, treating costs go up and well return decreases.

In old fields where wells were drilled along boundary lines and are unevenly spaced over a tract, fracturing may be especially productive because drainage is uneven and relatively undrained areas may be tapped.

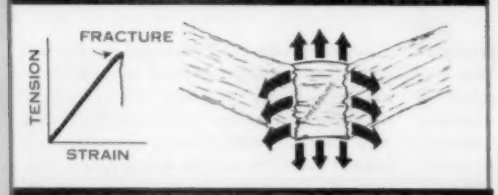
5 Most successful fracture treatments pay out within 3 to 6 months and some will pay out in a matter of a few weeks. The time depends both on the producing rate of the well at the time of fracturing and the size of the treatment.

Length of payout time may not be a primary consideration for choosing a particular treatment. This is because the cost of the treatment is usually small with respect to the increased production income. Even though treatment cost will increase with size of the treatment and payout time will also increase, a larger treatment may recover more oil and thus be more profitable. Actual experience in a given area is the best guide in selecting treatment sizes.

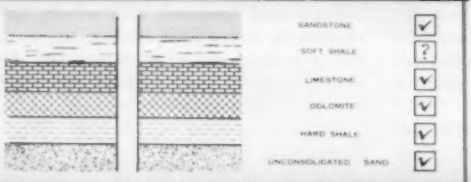
Mechanism...

FORMATION OF FRACTURES

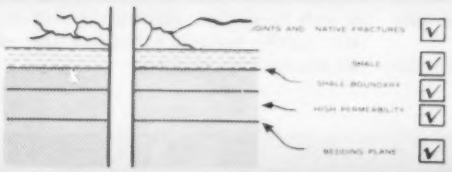
TENSILE ROCK FRACTURE



FORMATIONS FRACTURED



WHERE FRACTURES START



1 **Why does hydraulic pressure cause well fracturing?**

2 **What type of formations can be fractured?**

3 **How deep can wells be and still be fractured?**

4 **Where will a fracture start in the well?**

5 **Will fracturing fluids affect the position of fractures?**

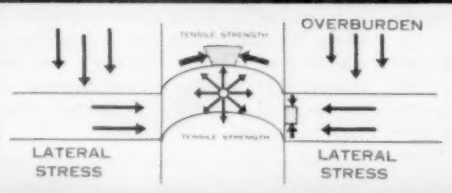
1 Well fracturing is the splitting of rock under tension. When rock is put under tension it will stretch in proportion to the applied stress, up to a point. This is the yield point. Other elastic materials, such as steel, deform plastically at this point and continue to stretch. But rock, being brittle, ruptures at the yield point with little or no plastic deformation.

Hydraulic pressure applied to the rock of the well bore creates tensile forces around the hole. When these forces become great enough, they finally pull the rock apart and start the split which is lengthened by the fluid pumped into the hole.

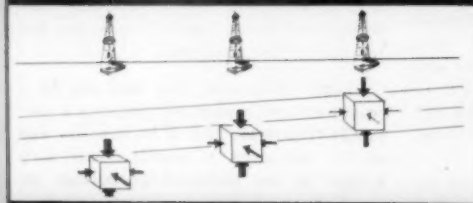
This definition, strictly, applies only to whole rock. During field fracturing treatments, formation rock sometimes is not actually fractured because it already exists in a fractured state. In these cases, fluid must only overcome confining stresses to open and extend the existing fractures.

BREAKDOWN PRESSURES

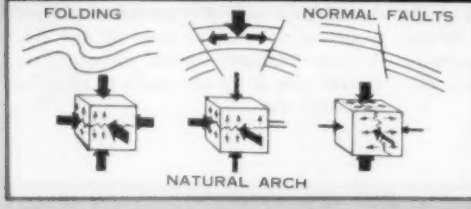
RESISTANCE TO FRACTURING



OVERBURDEN STRESS



EFFECT OF GEOLOGY



1 **What affects breakdown pressure of formations?**

2 **Is the amount of overburden load important?**

3 **What is the relative effect of rock strength and earth stress?**

4 **Do geological features have any affect on breakdown?**

5 **Are breakdown pressures consistent in a given formation?**

1 Around a hole in a formation, the resistances to fracturing are compressive stresses in the rock and the strength of the rock. Both stress and strength have the same units as does pressure.

At the wall of the hole, only two principal stresses exist. That is the axial stress and a tangential stress. The radial stress at the hole is zero but increases to formation horizontal stress with distance from the hole. Around the hole, the tangential stress will be uniformly twice the horizontal stress out in the formation provided the horizontal stress is uniform. It decreases to horizontal stress with distance from the hole.

When the pressure becomes great enough to overcome either the tangential or axial stress or the combination of both stresses in any direction plus the tensile strength in that direction, the formation will part.

2 For holes in rock formations at the surface, tensile strength only must be opposed for pressure to start a fracture. For small holes in rock specimens, break-

2 All formations which behave as elastic materials will fracture. Formations that won't fracture are those that tend to flow or deform plastically when pressured.

Fracturable formations include consolidated sandstones, limestones, dolomites, granite washes, and hard or brittle shale. Very soft shale or clay generally won't fracture. These are the types of formations which flow into the hole during drilling. Unconsolidated sand behaves somewhat like a plastic material. That is, it tends to flow when stressed. It does not part until well-bore pressure nears the overburden load.

3 Fracturable formations exist at least to 20,000 ft. This is evidenced by cases of lost circulation of drilling mud into compact formations at such depths. But the deeper a well goes, the higher is the pressure required to fracture it. At extreme depths, some believe that all formations behave plastically and can be parted only by pressure exceeding overburden load.

Successful fracturing treatments for the purpose of well stimulation have been performed in formations as deep as 12,000 ft.

4 Fractures begin in the well at the points where the combined resistance of compressional stress and tensile strength of the rock is lowest. When the pressure becomes high enough to overcome the least compressional stress, the fracture will begin at the point that has the least strength in a plane normal to the direction of that stress.

Likely points for fractures to start are native fractures, joints, and bedding planes having no tensile strength. Another frequent position is in highly permeable rock which usually has low tensile strength.

5 Fracturing fluid will affect the position of fractures in some cases because it affects the distribution of pressure on the formation. In wells where the tensile strength of the matrix rock is high and vertical compressional stresses are low, a fluid which leaks off into bedding planes or high permeability sections will help to start horizontal fractures at these points. When native fractures exist, the fluid that leaks into them creates a pressure or stress wedge that will open them at a lower well pressure than if they were sealed at the well bore. This pressure may be less than the least stress in the rock comprising the wall of the hole.

A fluid which seals these places, however, prevents such pressure wedges and causes uniform pressure distribution around the hole. In this case, the initial fracture position has to be normal or near normal to the direction of least stress, in a plane where rock strength is lowest. Such fractures will usually be vertical, at any depth, and will start in high-permeability or weak sections.

down pressure or effective rock strength may be much higher than for holes the size of normal well bores.

As the well bore goes deeper, however, overburden stresses must be added to the effect or rock strength. The overburden load is felt both in the vertical and the horizontal directions. The horizontal component of the overburden stress is due to the inability of the rock to expand laterally when under load from above.

3 Fracturing of most formations usually occurs at pressures less than or equal to the overburden stress. Overburden stress of sedimentary formations is about 1.0 psi. per ft. of depth. Horizontal stress induced by the overburden will range from about 0.2 to 0.4 psi. per ft. of depth. Many fracturing pressures, however, will be about 0.7 psi per ft. of depth because of rock strength and concentration of stress around the hole.

Tensile strength across bedding planes, native joints, and fractures may vary from zero to about 200 psi. Strength of porous sandstones and limestones is about 200 to 1,000 psi. And tight formations have strengths up to 2,000 to 3,000 psi.

In deeper wells, tensile strength is naturally less of a factor than in shallow wells because of higher stresses. For vertical fracturing in a 5,000-ft. well, for example, resisting tangential stress will be twice horizontal stress or about 3,333 psi. for a gradient of .67 psi. per ft. If tensile strength is 700 psi. the gradient is increased to only .81 psi. per ft.

For the same type of fracturing in a 2,000-ft. well, tangential stress would be 1,333 psi. and a 700-psi. tensile strength would increase the pressure gradient to 1.02 psi. per ft. At the same time, resisting stresses would be 1.0 psi. per ft. on a horizontal bedding plane, .67 psi. per ft. on a fracture 45° from vertical, and .33 psi. per ft. on a vertical fracture. These need be permeable to be opened, however.

4 Earth movements will change the normal stresses set up by the overburden. In areas where severe folding of sediments occurs, fracturing pressures at a given depth are usually higher than in areas characterized by normal sedimentation loading.

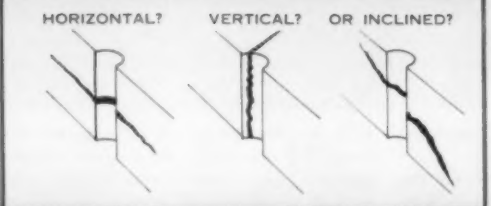
Low vertical stresses can sometimes result because of movements resulting in the weight of overlying sediments being borne by bridging action. But such rock bridges are relatively weak and will not span distances of reservoir size unless the arch is about as high as it is wide.

5 In a given area, breakdown pressures of a formation will be fairly consistent. Exceptions may be in limestone or conglomerate where porosity and binding strength may vary widely.

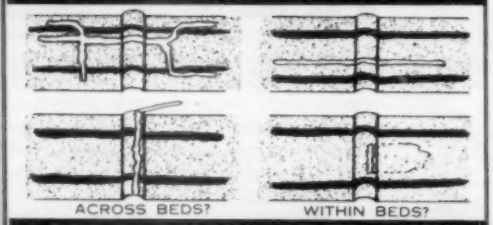
Type of fluid will affect this pressure, however. Penetrating fluids will give a lower pressure of breakdown since they act directly against formation stresses at weak planes rather than against the concentrated stress and the strength of the rock of the bore hole.

FRACTURE EXTENSIONS

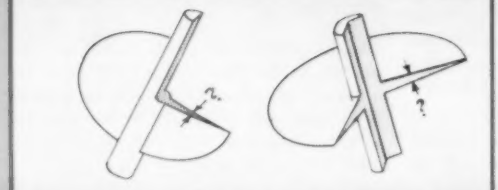
FRACTURE POSITIONS



WHERE DO THEY GO?



WIDTH DURING INJECTION



1 **How do fractures orient themselves in the formation?**

2 **What pressures are needed to extend fractures?**

3 **Does injection rate have any effect on fracture position?**

4 **Do shale beds have any effect on extension?**

5 **What determines the distance the fracture goes?**

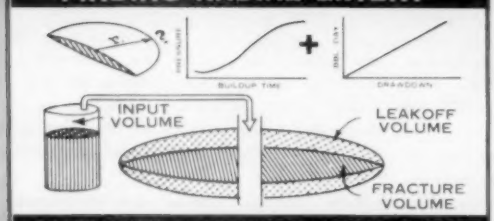
6 **How wide are fractures during extension?**

1 Orientation of fractures is the subject of considerable controversy. Most interpretations are that horizontal fractures predominate. But present methods, while indicating the point of entry of the fracture, do not tell where the fracture goes. Similar well-bore surveys could be obtained from vertical fractures of limited height or fractures slightly inclined from the vertical as from horizontal fractures. For instance, fractures 45° and 20° from vertical in a 9-in. hole would intersect the hole over intervals of only 9 in. and 4 ft.

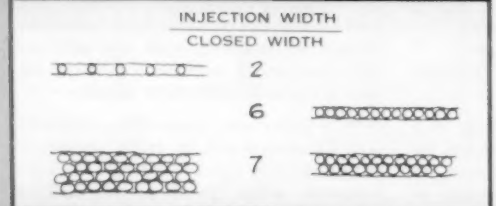
Fractures will seek positions normal to the direction in which the sum of the formation stresses and tensile strength of the rock is least. If this direction changes as the fracture leaves the bore hole, the fracture direction will change. For shallow wells, down to about 2,000 to 3,000 ft., horizontal stress plus horizontal strength is about as much as the vertical stress. Horizontal fractures, then, are most likely to occur. In deeper wells, the difference in the vertical and horizontal stress is so much greater than tensile

FRACTURE IN PLACE

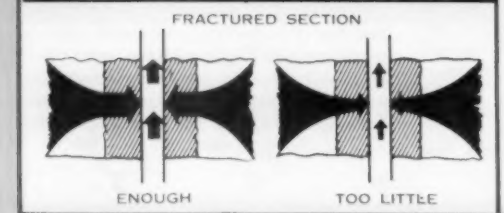
FINDING RADIAL EXTENT



CHANNELS AFTER TREATMENT



FRACTURE CONDUCTIVITY



1 **How can you determine the radial extent of the fractures?**

2 **What are the fracture channels like after the treatment?**

3 **Can you be sure the fractures have enough conductivity?**

4 **Can well surveys accurately locate the position of fractures?**

5 **How likely are fractures to extend to water zones?**

6 **Will fracture-fluid conductivity change with time?**

1 Provided you assume regular geometrical shapes of a fracture, such as a circle, an ellipse, or a long band, you can determine the radial extent by leakoff and volume estimates. Leakoff rate at any point decreases with time of contact, so that the greatest rate of leakoff occurs at the fresh surfaces at the end of the fracture.

As a result, a profile of total leakoff along the fracture will be roughly a quadrant of an ellipse and average leakoff per unit area along the radius of the fracture may be assumed to be about two-thirds the leakoff on an area near the well bore. Width of fractures may be assumed on basis of theory for vertical fractures, above, or about ¼ to 1½ in.

Another means of estimation is from pressure buildup curves and P.I. tests. These methods determine reservoir permeability beyond the fracture and combined fracture and reservoir permeability. Radius can be estimated only by the assumption of an average permeability of the fractured region.

strength that vertical or near-vertical fractures should predominate.

2 Theories of fracture extension in isotropic, impermeable, elastic media indicate that the necessary pressure should be twice the confining stress plus the tensile strength. But field evidence for natural rock formations does not generally confirm this. For instance, pressures twice the magnitude of the overburden for extending horizontal fractures seldom occur. But vertical-fracture extension pressures generally obey the rule, which is about two-thirds of overburden stress.

Reason for such behavior may be that where tensile strength is practically nil on a fracture plane in a permeable medium, fluid advancing ahead of the fracture eliminates the concentration of stresses at the end of the fracture.

3 Planes of low strength will frequently break in preference to whole rock if the fracturing fluid can penetrate them and apply pressure to the faces. Thus slow pumping rates allow fluid to enter these planes sufficiently fast for the fracture to follow it. This technique has been used in some areas to obtain fractures which do not extend in a vertical direction, in order to prevent fracturing to water.

4 Some shale beds that are brittle or hard will not restrict fractures at all. In fact, in some areas these shales may fracture in preference to permeable rock. However, clays or softer shales that tend to deform plastically may, where several feet thick, stop fractures.

When the edge of a fracture approaches such beds the stress causes plastic-yielding rather than a cleavage. And the fracture goes no farther in that direction.

5 Extension length of fractures depends on the volume of fluid leakoff, the volume retained in the fracture, and the geometry of the fracture. Amount of leakoff depends on viscosity, permeability, and time, or filter loss and time. Volume of fracture depends on the compressibility of adjacent formations and the difference in stress between the fracture wall and the adjacent formations.

The relative effects of these factors are poorly known at present. In some cases fractures are known to have extended 1,000 ft. in only one direction. Even if regular geometrical shapes occur, much better estimates of stress differences and compressibilities than presently available must be known to pin down actual fracture lengths.

6 Where fracture mechanism obeys theory, fracture widths may be estimated. For vertical fractures in homogeneous formations, the difference between fracture pressure and formation stress is about .33 psi. per ft. of depth. For sandstones and limestones, calculated fracture widths at the end of ordinary treatments will vary from ¼ to ¾ in. at depths of about 3,000 ft. and ½ to 1½ in. at 10,000 ft. However, width is proportional to length and the fracture width will be much less at the start of a treatment.

Stress differences and compressibilities are not known very well for fractures in other directions. But field evidence of particle injection indicates widths of up to ½ in. may be expected during fracture treatments.

2 At the end of the fracture treatment, the fractures are filled with a slurry of sand in a fluid. Fluid has continually leaked off into the adjacent walls during treatment and will continue to leak off until the walls close down on the sand. For a fracture that is ½ in. wide during injection and which contains an average sand slurry of 1.5 lb. per gal., the closed width will be about 0.05 in. or 2 layers of sand. But because of leakoff during the treatment, the concentration may range from this value near the well bore to as high as 30 lb. per gal. near the end of the fracture. Sand-packed width at this point would be equal to width during extension.

3 For 20-40-mesh sand and usual fracture treatments, fracture conductivities near the well bore will range from about 500 to 3,000 md.-ft. This is usually the lowest conductivity portion of the fracture, since leakoff concentrates the sand further out. For formations of about 10-md. permeability, this range of conductivity is probably adequate. In more permeable formations higher conductivities should produce better results.

Some operators get the higher conductivities needed around the well bore by increasing the sand concentration toward the end of the treatment. However, in the case of sand settling in vertical fractures or where sand is washed away by overflushing, fracture conductivities near the well bore could be too low for optimum results.

4 Present well-survey methods are really too insensitive to tell very much about the position of fractures. They can determine the general zone of fracturing, however, because of the high fluid injectivity at the intersection of fractures with the well bore. Most injectivity surveys now used require a high rate of fluid for best results.

Use of radioactive sand or fluid to mark the fracture position has been only partially successful. Problem is contamination of nonfractured zones which gives false readings. Also the tool will ride one side of the hole and give misleading interpretations of the entire hole.

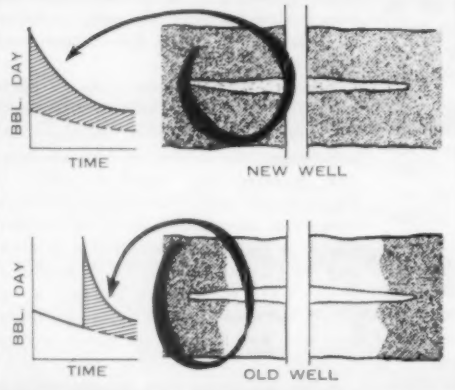
5 When the oil-water contact is within 20 to 30 ft. of the perforated interval there is a good chance of the fractures extending to water. This has happened in some areas despite all efforts to prevent it. In other areas, fracturing has not brought in water and most people explain this by postulating horizontal fractures. Because of fracturing pressures, however, it seems that vertical fractures of limited height may be occurring in these cases. Sometimes fast injection rates bring bottom water where slow rates in the same situation give good results without water.

6 Where uniform, round sand in a concentration of at least 1 lb. per gal. is used in fracturing, fracture conductivitiy will usually not change with time. If no sand or sand in a very low concentration is used, the fractures tend to heal with time. Normally the walls of the fractures are pressed together by high stress and a few scattered grains of sand distributed over the surface will gradually break or be forced into the matrix. Very rapid production decline then results.

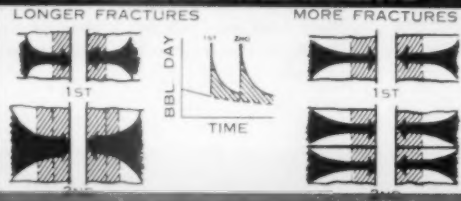
Results...

WELL BEHAVIOR

FLUSH PRODUCTION



SUCCESSIVE TREATMENTS



1
Why does flush production occur after the treatment?

2
What causes a rapid decrease in production after the initial flush?

3
Can any particular method of treatment insure sustained production increases?

4
Why will a succeeding fracture treatment create a higher production rate than the first.

5
How many successive treatments will be economically successful?

1 Unusual flush production after the fracture treatment is in part due to the pressuring effect of the load oil forced into the formation and in part due to the redistribution of reservoir pressure around the fracture.

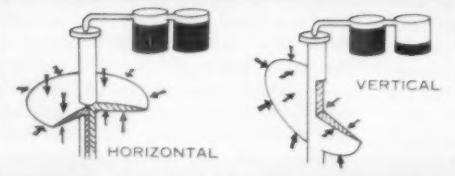
After the load oil returns, pressure begins decreasing throughout the reservoir. At first, the rate of pressure drop is faster than the rate of production. This is called the unsteady flow period. The period during which pressure declines at the same rate as production is the settled flow period.

Since the fractured system will reduce a much larger portion of the reservoir to bottom-hole pressure than a single well bore, more oil is produced during the unsteady flow period. As a result, unusual flush production occurs.

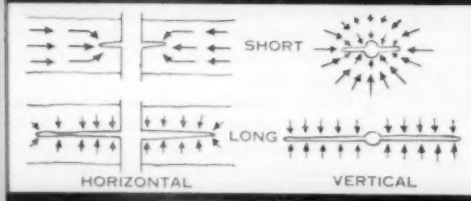
2 Production decline after a fracture treatment is usually only the normal result of depleting the reservoir. Since the fractures decrease flow resistance, allow-

RESERVOIR EFFECTS

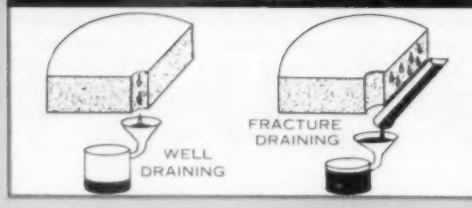
EFFECT ON PRODUCTIVITY



FLOW PATTERNS



MORE OIL?



1
How much is the flow resistance of the reservoir changed?

2
What methods can gage the effectiveness of the treatment?

3
Is there any productivity advantage of either vertical or horizontal fractures?

4
How is the drainage pattern changed by fracturing?

5
Will the reservoir drain more oil into a fracture than it would to the well bore?

1 Theoretically, flow capacity of wells will normally be increased about 100 to 400 per cent by hydraulically induced fractures 50 to 100 ft. long. Treatments of 5,000 to 10,000 gal. will create fractures of about this length. For horizontal or vertically limited fractures, this increase is dependent on the thickness of formation. The relative capacity will decrease with increasing thickness.

Longer fractures can create even greater increases in capacity provided fracture conductivity is great enough. Electric-analog studies of all types of fractures have shown that flow capacity of homogeneous formations can be increased at least 10 times by fractures approaching the theoretical radius of drainage.

It is well to remember that these values are for uniform permeability. If flow resistivity before fracturing is greater around the well than in the reservoir, flow-capacity increases of much greater magnitudes will be observed.

ing larger production rates, the given volume of oil in the reservoir is depleted quicker and the production rate declines accordingly.

The corresponding portion of the decline curve for the unstimulated well is much flatter because of its ability to produce less oil for a given reservoir pressure. For a new well that is unstimulated, the high-rate period of production may not show up because of local well-bore blockage.

3 Sometimes, different types of fracture treatments produce different rates of production decline in wells in the same pool. The effects of load-oil pressuring and unsteady flow tend to obscure this during initial production.

In general, where initial rates are the same, a well with a shorter fracture radius will decline to a lower settled production. Another cause of fast decline is the creation of fractures in narrow isolated sections of the pay. These may be depleted rapidly.

Treatments that have given best sustained production rates are those having fast injection rates and low fluid leakoff, combined with high fluid volumes. These are merely means of getting more fracture area.

4 Successive fracture treatments frequently give new increases in oil. Usually there is a period of flush production after each treatment which largely accounts for the increased oil. In a homogeneous reservoir, the settled rate after each job may be about the same. But in a reservoir with laminations or permeability stratification, successive treatments may increase settled production rate.

In many cases, this new oil is due to lengthening of the original fractures. Flush production occurs because of pressure redistribution. Even though flow resistance is less than after the initial jobs, the reservoir is further depleted and settled rate may not be increased.

In other cases, the new oil results from creation of fractures into new zones of production. Where vertical permeability barriers exist, all the zones may not be fractured by the initial jobs. When these zones are opened, settled production rate may even exceed the rate after the initial fracture treatments.

5 Success of additional fracture treatments depends on the ability to expose new formations on each fracture treatment. Unless successive treatments use techniques designed to push fractures farther out in the formation, they may not improve the initial treatment.

Where initial treatments using only a small amount of sand and fluid have been successful, larger treatments will usually also be successful. In a new area, many operators purposely perform a small treatment on wells initially, then after observing the reaction of the well, follow it up with a large treatment. As many as three treatments have been successful on some wells.

2 The best means of evaluating the fracture treatment is productivity-index and pressure-buildup tests before and after. By comparison of the ratio of permeabilities from the productivity-index test and the pressure-buildup test the relative flow capacities near the well bore and in the reservoir may be obtained.

If there is vertical permeability segregation and the fractures intersect only part of the formation, the ratio of permeabilities from the P.I. and buildup tests may make the fracture treatments appear too good. Since only part of the formation is affected, permeabilities calculated from both tests will be too low. In this situation, injectivity tests should be run to determine if further facturing would open more reservoir and increase well productivity.

3 In thin formations of good vertical permeability, a horizontal fracture will increase the flow capacity of a well more than will a vertical fracture. But the advantage decreases with increasing formation thickness. Beyond about 50 ft. thickness, the vertical fracture will give better capacity provided it extends upward as far as it does outward.

Where vertical permeability is low, the vertical fracture will give best results unless enough horizontal fractures are present to completely tap the formation.

4 Many people like to think of a fracture as merely increasing the radius of the well bore. For a horizontal fracture in a thin reservoir this is not far wrong. But for vertical fractures, the pressure distribution changes as flow is diverted toward the fracture instead of the well bore.

For horizontal fractures of a circular shape, tests have shown that radial isopotentials beyond the fracture are changed little by the fractures. However, vertical flow occurs from the formation above and below the fractures. Around vertical fractures, however, there is considerable redistribution of isopotentials. Flow is linear into the fracture, then gradually fans out as the distance from the fracture increases. After distances roughly equal to the length of the fracture, the flow pattern approaches radial.

The noncircular pressure pattern around fractured wells has been suggested as a means of determining the shapes and directions of the fractures. The fracture pattern may be estimated from observations of producing pressures in wells surrounding a fractured well.

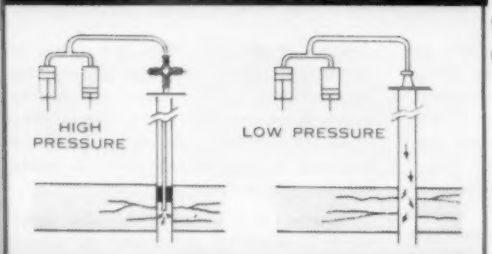
5 At the present time, the subject of draining more oil from a fracture than from a well bore is somewhat akin to the subject of whether closer spacing of wells will better drain a reservoir.

In a gas-expansion-type reservoir, if the efficiency of drainage decreases with distance of drainage, fractures should increase the efficiency of reservoir depletion. The magnitude of this effect is not known but has been estimated to be as high as 5 to 15 per cent of primary recovery.

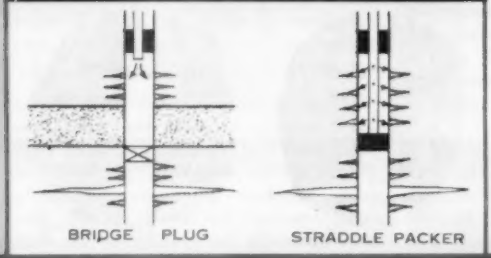
Techniques...

PREPARING THE WELL

FRACTURE STRING



ZONE ISOLATION



1
What kind of wellhead equipment should you have?

2
When is it best to fracture-treat through tubing?

3
What is the danger in treating down casing?

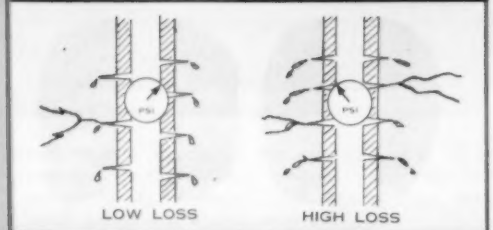
4
How much production zone should be fractured at a time?

1 You can usually use normal high-pressure wellhead connections and tubing for fracturing, provided injection rates are low. The service company will provide the necessary piping to connect the pump trucks to the well. But you should check all fittings to be sure that each is rated above the expected fracturing pressure. This may be as much as 1,000 to 2,000 psi. even for shallow wells. Some companies require connections to stand as much as 1,500 psi. above expected pressure.

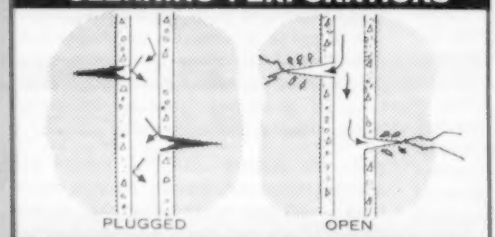
For big jobs, employing high rates of injection, the tubing may be pulled so that fluid is pumped directly down the casing. A large flanged swage nipple and, where needed, a blowout preventer connect the pump lines to the casing. However, where there is no packer, some operators leave tubing in and pump di-

BREAKDOWN METHODS

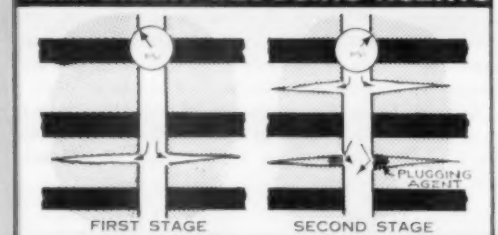
FLUID LOSS



CLEANING PERFORATIONS



TEMPORARY PLUGGING AGENTS



1
How can you minimize breakdown pressure?

2
What should you use to clean formation and perforations?

3
Should you attempt to control fracture orientation?

4
How much will low-fluid-loss fluid increase breakdown pressure?

5
Can you insure opening lower-permeability sections?

6
When will temporary plugging agents be of value?

1 Breakdown pressure depends both on the ability of the fluid to reach the formation and on the formation strength and stress. Thus to obtain the lowest breakdown pressure, you must make sure that the formation is clean and that perforations are unplugged. In most cases where formations don't break with the application of maximum allowable pump pressures, the fluid is not being applied to the formation. Usually after a well-wash, breakdown occurs at a much lower pressure.

When a formation is fully exposed to the fracturing fluid, minimum breakdown pressure will occur when the fluid can leak off into the formation. Because of the microscopic nonhomogeneity of reservoir rock, the entrance of fluid into the pores on the surface will decrease the tensile strength. And the fluid can create stress wedges on planes of natural weakness and permeability.

Lease oil from the formation being fractured is probably the best fluid with which to obtain minimum breakdown pressure.

2 Acids and surfactants have proved helpful to fracturing in cleaning mud from perforations and opening the pores of the formation. One type of acid mix-

rectly into the casing-tubing annulus at rates up to 20 bbl. per minute using both sides of the casing head. Sometimes both tubing and annulus flow is used. Sand cutting of tubing opposite the casing-head opening has apparently been no problem in most cases.

Be sure that the pumping lines or manifold are tied down securely, otherwise pumping vibrations may cause wellhead-equipment failure and possible resultant fire hazards.

2 Treating through the tubing is performed where casing will not stand the fracturing pressures or where zones must be isolated. Tubing packers are used to isolate the interval to be pressured.

Care should be taken that the casing is supported with good cement behind the packer-setting points. Also observe casing-head pressure at all times during the treatment to detect a possible packer leakage which could damage the casing. Tubing yield pressure will vary: about 3,000 psi. for F-25, 5,000 psi. for H-40, 7,000 psi. for J-55, 11,000 psi. for N-80. Where breakdown pressure is high, injection rates must be kept low because friction pressure will increase rapidly with rate.

3 Fracturing down casing is dangerous in many cases because the casing is lightweight and of a low-strength grade. Casing corrosion, both internal and external, may reduce strength severely. Remember that in most cases, the pressure on the casing will be from 0.6 to 1.0 psi. per ft. of depth, offset by whatever fluid column, if any, exists outside the casing.

Using a higher-strength casing than needed for the well pressure itself may be advisable for well completion where fracturing is anticipated. Yield pressures of 5½ and 7-in. casing will range from about 2,000 to 11,000 psi. A popular casing for fracturing completions is 15.5-lb. 5½-in. J-55 casing which has a yield pressure of about 5,000 psi.

4 You should not attempt to fracture more than about 50 ft. of pay interval during any one stage. If a single horizontal fracture is formed, its drainage effectiveness will decrease appreciably for greater thicknesses. Another problem is the creation of one vertical fracture or a number of fractures over the entire interval at one time. Fluid entry may be reduced for any given fracture interval to the point that the fractures are not extended very far from the well bore. Rapid productivity decline after the treatment usually results.

ture contains hydrofluoric acid which dissolves and disintegrates mud particles and mud cake. Another type has hydrochloric acid to disperse the mud particles and a surfactant to reduce clay swelling and remove blocking water.

Surface-active materials dissolved in oil have also been effective in removing mud blockage. One type apparently causes release of bound water from mud and clay and disperses these solids so that they can be removed from the formation face.

3 The only method in use for controlling fracture orientation is to break down the formation with a fluid that will seal the surface of the formation without any fluid loss. All that this will do is to increase the chance of formation of vertical fractures. No way is available to insure horizontal fractures though use of a fluid that will leak off will increase the chances.

Vertical fractures are desired primarily for opening formations that are laminated with shale or that have low vertical permeability. However, the use of a special low-fluid-loss breakdown fluid may not be needed to obtain vertical fractures. In many areas, below depths of 2,000 to 3,000 ft., vertical or near vertical fractures are more likely than horizontal fractures. Here the extra pressure needed for use of the special break down fluid may not be desired.

To determine the manner of normal fracturing, break down with a fluid such as crude oil. Observation of the pressure required and an injectivity survey of the well should tell you if the extra expense of a special fluid is needed.

4 When you use a low-fluid-loss fluid to break the formation, the pressure may increase 500 to 2,000 psi. over the pressure required with the use of crude oil. The magnitude of this pressure increase is about the same as the tensile strength of the rock. One explanation of this pressure difference is that the fluid is prevented from entering permeable planes of low strength which are inclined away from vertical. These planes would fracture with a high-fluid-loss fluid in preference to a vertical plane of high strength. Another possibility is that fluid which imparts pressure to the microscopic pores causes lower resistance to stress.

5 Where the stress distribution around the well favors horizontal fractures, low permeability sections will be bypassed in preference to the higher permeability sections. Even where vertical fractures are formed, the fractures may extend outward in the more permeable sections instead of upward or downward in low permeability rock. This would be due to the lower tensile strength of the more permeable rock.

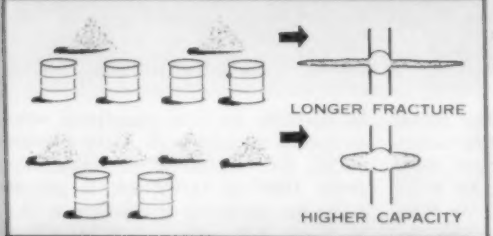
Probably the most effective way to open these tight sections is to perforate and fracture them separately. Sufficient distance must be left between each set of perforations, however, to insure proper seating of a packer.

6 Where a perforated interval consists of tight and permeable sections that can't be separated by a packer, the use of multiple-stage fracture treatments sometimes helps open the tight zones. In these treatments, the fracturing sand and fluid is divided among the stages. After the sand is injected for each stage, the fracture is plugged by a large-grained material such as napthalene which will dissolve slowly in oil. Then, pressure is increased until the formation breaks and the next stage of sand is injected. After all stages, the well is shut in for a number of hours so that the oil dissolves the plugging agent.

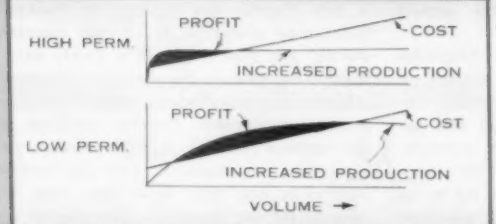
An increase in pressure for each successive breakdown is usually evidence that new fractures are created.

SIZE OF TREATMENTS

FORMATION PERMEABILITY



SAND AND FLUID



1

How should you size a treatment on the basis of feet of formation?

2

What's most important, the volume of fluid used or the amount of sand?

3

Should the size of treatment vary with formation permeability?

4

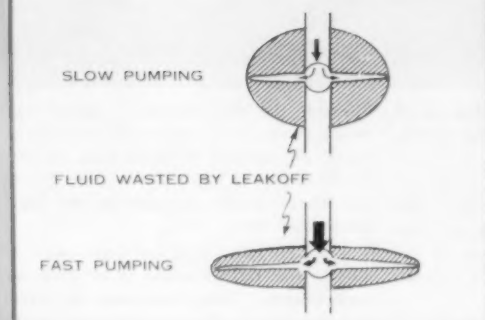
Will a single large volume give as good results as the same volume placed in stages?

1 An average treatment today will be about 500 to 1,000 gal. of fracture fluid to each foot of formation to be fractured. The quantity of sand will vary between about 500 to 2,000 lb. per ft. of formation. Most of the large-volume fracture jobs of, say, 50,000 to 100,000 gal. are on formations 50 or more ft. thick.

Treatment sizes have been increasing continuously since the advent of hydraulic fracturing. Where average gallonage would be about 3,000 to 4,000 a few years ago, average volume has increased to about 7,500 to 8,500 gal. per treatment. The reason for bigger treatments is that they can produce larger production increases. Increased cost may be quite small compared to the extra oil procured. When a formation is known to respond

PUMPING RATES

RATE OF PUMPING



1

What effect does high-rate pumping have on fracture results?

2

How fast should the fracturing fluid be injected?

3

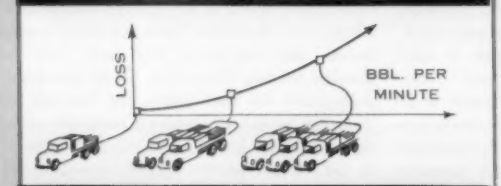
Does pumping rate affect fracture position?

1 In the early work in hydraulic fracturing, injection rates were low because most fracture treatments were performed down tubing. Since that time, the trend has been toward increasing injection rate. This has necessitated treatment down casing to minimize friction losses and the use of many pumping trucks.

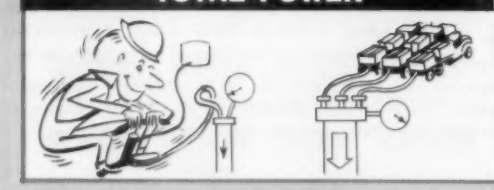
Faster pumping is a means of minimizing the loss of fluid from the fracture walls during treatment. The total fluid volume is put away faster and has less time to leak off to the matrix porosity. As a result, more fluid is contained in

POWER NEEDED

FRICTION LOSSES



TOTAL POWER



1

What is the relation between the power lost to friction and that required for fracturing?

2

How do you determine the amount of pumping power needed?

3

What is the power range of available pumping units?

1 In many down-tubing fracture treatments, most of the observed surface injection pressure is due to friction loss. For a rate of 5 bbl. per minute of a 100-cp. fracture oil, the loss will be about 0.3 psi. per ft. for 2½-in. tubing and 0.8 psi. per ft. for 2-in. tubing. Increasing the rate to 10 bbl. per minute will increase the loss to 1.0 and 2.6 psi. per ft. for the two strings. However, the loss in 5½-in. and 7-in. casing at 40 bbl. per minute will be only 0.4 and 0.1 psi. per ft.

As an example of lost power due to friction, take a 5,000-ft. well being fractured through 2-in. tubing. Bottom-hole

to fracturing, a big treatment is more economical than several successive small treatments.

2 Apparently, for most formations fractured, optimum sand concentration will be less than about 3 lb. per gal. In many areas, 1.5 lb. per gal. is sufficient. Obviously, increasing the amount of sand for treatment of these formations without increasing the fluid volume will not increase well productivity. And increasing the sand concentration may actually decrease the productivity response to fracturing if it causes premature sand bridging so that all the fluid is not injected.

As long as average sand concentration is maintained at about 1 lb. per gal. and sufficient sand is left around the well bore, increasing the volume of fluid will increase well productivity. This depends on the increased fluid extending the fractures. If leakoff takes all the extra fluid, no benefit will result.

3 If formation permeability is in excess of about 200 md., large fracture treatments will probably do no more good than small ones. Treatments of 100 to 200 gal. per ft. of formation will probably break through any permeability block and yield maximum results.

4 In a formation with large permeability variations, you should use a large enough treatment to form fractures in all sections. Otherwise, only part of the reservoir may yield increased production. In a homogeneous formation, a single, horizontal fracture will have a longer radius and thus increase productivity more than a number of horizontal fractures formed with the same volume of fluid. This is true provided formation thickness is less than about 50 ft.

Where vertical permeability barriers exist, however, the use of a given volume of fluid to form a number of fractures in different sections will give better productivity results.

If vertical fractures form, a single fracture created by a given fluid volume will give better results than a number of fractures, provided all fractures extend to same height. If the fracture does not extend very far vertically, several fractures in different intervals will be better.

the fractures, the fractures are longer, and higher well productivity results. This advantage is being offset somewhat by use of low-fluid-loss fluids which also help to get longer fractures at all rates.

Another advantage of fast injection of the fracture fluid is that it will move the sand farther before it settles out. Of course, this may not be important where gelled fluids are used, but it undoubtedly contributes to fracturing success with refined and crude oils. In vertical fractures, better treatments are assured because sand is left over most of the vertical height. In horizontal fractures, high fluid rate keeps the sand moving where it might become lodged and cause a sandout.

2 Pressure limitations of tubing are such that rates of more than about 10 bbl. per minute of fracturing fluid can not be injected in this way, unless the well is very shallow. Usually, rates down tubing will be about 3 to 5 bbl. per minute.

Pressure drop due to flow is much less in casing, however, and rates as high as 75 bbl. per minute down casing have been successfully used in wells 8,000 to 10,000 ft. deep. For this type of treatment, about 40 bbl. per minute is average.

3 In the Illinois basin, some operators have apparently been able to control the direction of fracture extension by varying injection rate. In these cases, rates of 5 bbl. per minute have created fractures that extend downward to the water table. Decreasing the rate to 1 bbl. per minute has eliminated fracturing to water. Gelled fluids are essential, however, to prevent sand settling and bridging during treatment.

injection pressure will be about 3,500 psi., but the fluid head will be about 2,000 psi., leaving 1,500 psi. at the surface. If a 100-cp. fracture oil is pumped at the rate of 5 bbl. per minute, the pressure loss will be 4,000 psi. Total injection pressure will be 5,500 psi. For 2½-in. tubing, injection pressure will be 3,000 psi.

You can see that over half the pressure and the horsepower is lost to friction in these cases.

If treatment were down 5½-in. casing the lost pressure would be only 600 psi. at 20 bbl. per minute and 2,000 psi. at 40 bbl. per minute. For these rates, injection pressures would be 2,100 and 3,500 psi.

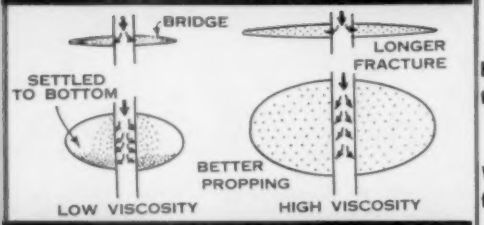
2 To determine hydraulic power needed for pumping, multiply the surface pressure in pounds per square inch by the pumping rate in barrels per minute and divide by 40. For example, to pump fluid at 5 bbl. per minute against a pressure of 3,000 psi. would require about 370 hydraulic horsepower. Twenty barrels per minute at 2,000 psi. would take 1,000 hp. And 40 bbl. per minute at 3,500 psi. would take 3,500 hydraulic horsepower.

3 The range of power of presently available pumping units is from about 200 to 700 hydraulic horsepower. Actual engine power will be about 50 per cent higher than the hydraulic power.

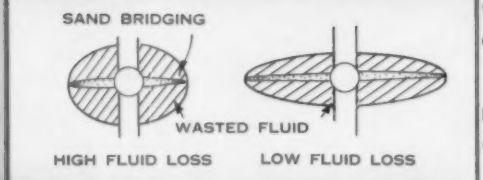
Some of the smaller units have a rather low-pressure rating and are used for high-volume, low-pressure treatments. The bigger units can go up to 10,000 psi. However, remember that their horsepower is essentially constant. Thus, at 10,000 psi., they can pump at only a tenth of the rate as at 1,000 psi.

FRACTURING FLUIDS

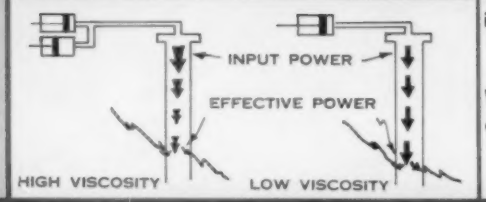
SAND SUSPENSION



FLUID LOSS



FLOW RESISTANCE



1
How high should the viscosity of the fracturing fluid be?

2
When do you need a thickened fracturing fluid?

3
Will reducing the fluid loss increase profits?

4
How well does lease crude work as fracturing fluid?

5
What is the effect of surfactants in the fluid?

6
When are other fluids better than oil for fracturing?

1 Viscosity helps you to suspend sand and lessen loss of fluid from the fractures, but it hurts you by increasing pumping pressure. This is particularly true of refined fracture oils and crude oils which behave as Newtonian fluids. However, it does not necessarily apply to special fluids such as gels and emulsions.

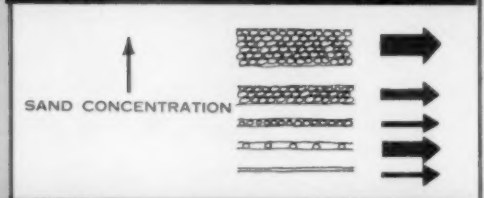
These latter fluids may have an extremely high apparent viscosity measured by a lab viscometer. But in flow through pipe, their viscosity will decrease rapidly with flow rate. At normal rates of fracturing the effective viscosity may be as low as or less than the actual viscosity of the base fluid. But still they will retain their sand-carrying properties.

Successful fracture jobs have been performed with minimum viscosities ranging from 1 cp. at high injection rates to 50 to 150 cp. at low injection rates. When non-Newtonian fluids are used, sand suspension and fluid-loss tests are more important than viscosity measurements.

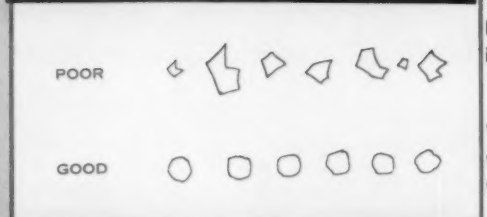
2 Although thickened kerosine or diesel has been in use from the beginning of

SAND

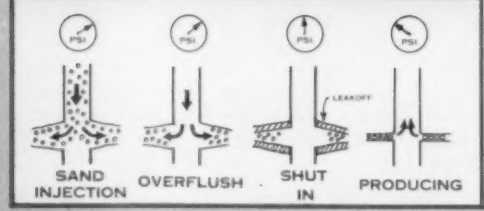
FRACTURE CONDUCTIVITY



SAND SHAPE



SAND RETURN



1
Does increasing sand concentration increase resultant productivity?

2
What type of fracture sand will give best results?

3
How can sand bridging during injection be avoided?

4
What measures should be taken to prevent sand return to the well?

5
Is there any danger in overflushing sand-free fluid at the end of the treatment?

6
What is the permeability of fracture sand when left in fracture?

1 Over the brief history of fracturing, average sand concentration for propping has gradually increased. Certainly part of this increase has come about because it has produced better treatments. But the increase may be partly due to the fact that sand is cheap and increased concentrations, if they can be injected, cost so little that they are worth trying.

In many areas, 1.5 lb. of sand per gal. appears to give optimum results. However, in some areas optimum concentration may be as high as 4 lb. per gal. Loss of fluid from the fracture, which concentrates the sand, has much to do with this variation. Increasing the sand concentration near the well bore where conductivity is most needed is probably better than increasing the average treatment concentration.

2 Sand injection for propping fractures should be uniform in size and rounded. Poorly sorted grains lead to lower fracture permeability and possibly crushing which will reduce permeability further. Round-grained sand works best because

fracturing, the original type has generally been displaced by high-viscosity refined oils and emulsions because of cost. Now, however, new additives are being used that will produce gels from crude oil or kerosine at costs no greater than viscous refined oils.

Advantages of the new thickened oils are better sand suspension than viscous oils, and lower pressure loss during pumping. For these, when made with a native crude or kerosine, the resultant thickened fluid will be more compatible with the formation oil, hence has less chance of becoming emulsified. However, care and special blending equipment are needed to obtain a good gel.

3 Reducing the filter loss of the fracturing fluid provides a means to keep more fluid in the fractures and thus to create longer and more productive fractures. Filter-loss reduction will improve productivity results whether injection rate is low or high. It will improve results with both high and low-viscosity fluids.

Costs of reducing fluid loss to, say, 10 cc. on the standard A.P.I. filtration test, will range from about 2 to 4 cents per gallon of fluid. This is usually a small part of the total cost of a treatment and even a few per cent increase in productivity will pay out the cost.

4 Lease oil alone has been used to inject sand for fracture treatments and may be sufficient if high injection rates of about 20 to 40 bbl. per minute are employed. However, because of its low viscosity, it will not support sand long and as a result hole sandups and fracture screenouts are frequent. High leakoff in the fracture helps promote screenouts, also.

For an extra cost of about 5 cents per gallon, the lease oil can be gelled to suspend sand and to improve treatments. This will lower fluid loss some but further reduction may be had for several more cents per gallon and will increase treatment effectiveness.

5 The primary use that has been made of surfactants in the fracturing oil is to prevent emulsions with formation water. Surface tests will usually show if this is needed.

There is a belief by some that surfactants will also increase well productivity even in the absence of emulsions.

6 Gelled acids and acid-oil emulsions have had good success in some carbonate formations of medium solubility. In these formations, the acid serves to open the pores of the fracture faces while sand holds the fractures open. However, these fluids are relatively expensive and results may be just as good with the larger-volume oil-sand treatments which can be used for the same cost.

Fracturing with water is cheaper than with oil and works well for some gas sands. In many San Juan basin gas wells, water does not harm permeability and a water-sand slurry injection at high rates has been very successful. Even water with no sand has produced good productivity results initially but fracture conductivity may not hold up over a long period.

it has less tendency to lodge in fractures.

Most operators prefer to standardize on one size of sand, 20-40 mesh. Finer sand, such as 40-60 mesh, has found application in some wells where fracture width is so small as to cause sand bridging of larger sand early in the treatment.

3 Sand bridging is minimized by low fluid-loss, good sand suspension, and high injection rate. It can be caused by sand settling or sand concentration increase due to loss of fluid.

If vertical fractures form, sand settling will cause most of the sand to accumulate near the bottom of the fracture. Although this may cause sand bridging, it is not likely to cause complete sand screenout. However, rapid loss of fluid may increase concentration to the point where the sand will neither settle downward nor flow.

In horizontal fractures, the sand is kept moving outward from the well in spite of the settling rate because of the velocity and washing action of the fluid. After a distance, however, fluid velocity decreases because of the increasing area and because of fluid loss. Sand starts to settle and becomes so concentrated it won't flow.

Low fluid loss, fast injection, and gel or high viscosity all help prevent bridging in these cases.

4 After all the sand injection, the tubing or casing is cleared of sand by pumping sand-free oil down the well to prevent backflow of sand, part of this sand-free oil is pushed on into the fractures. This volume varies with the type of oil and its intended purpose.

For chasing thickened crude or viscous refined oil, many operators like to use a flush of several hundred barrels of crude oil. This not only clears sand from the well bore but helps thin the treating oil to decrease cleanup time. For most jobs, however, an overflush of about 10 to 40 bbl. of crude is used.

Another important method of eliminating sand return is to allow the pressure due to treatment to decline or dissipate entirely. Shutting the well in, after treatment allows the treating oil to leak off and the fracture wells to close down on the sand and hold it in place.

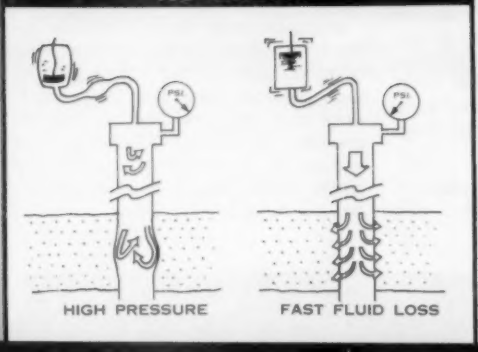
5 The fact that overflushing moves sand away from the well bore indicates that it may decrease production. Fractures need the most conductivity right next to the well bore, for at this point practically all of the production must pass. Sand-packed fractures assure that this conductivity will be maintained for long time intervals. Fractures not filled with sand may have high initial conductivity but may close or heal in a short period of time.

6 Permeability of packed 20-40-mesh sand will average about 300 darcies. Average for 40-60 mesh is about 100 darcies and for 10-20 mesh is about 1,000 darcies. According to tests, if only one layer of sand is left in the fracture, the permeability may be as high as 5,000 darcies. However, this decreases with clamping pressure, and, if the sand grains are unable to hold the walls apart, may decrease to practically zero.

Why Does Fracturing Fail ?

NO FRACTURE OBTAINED

NO BREAK



Breakdown pressure too high.

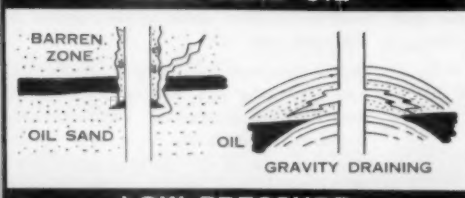
Well takes fluid without fracturing, or sands up.

No break . . . If you can pressure up the well to pressures exceeding 1 psi. per ft. of depth without a break, the perforations are probably plugged and the well needs cleaning out. Most porous formations will fracture below this pressure unless they are shallower than about 2,000 ft.

When a formation is completely exposed to the fracture fluid as in open

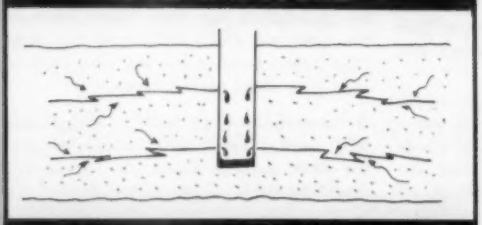
NO PRODUCTION INCREASE

LOST LOAD OIL



Well won't return load oil.

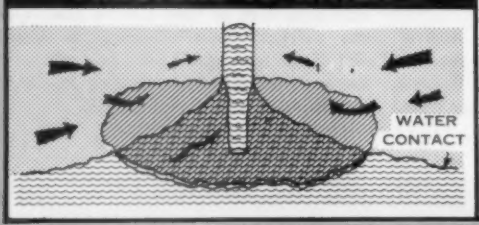
LOW PRESSURE



Load oil recovered but well dies.

Production increases until load oil returns, then declines to former rate.

FRACTURE TO WATER



Oil production decreases, water increases.

Oil production up, but water-oil ratio increases.

Lost load oil . . . This is evidence that you have fractured a barren formation. However, it may not be the pay zone. Did the fracture fluid leave around the casing shoe? Was the cement job competent in the perforated intervals? If you lost the fracture oil in open hole you can run an injectivity test to determine where it went. It's much harder to tell if the fluid channeled through the cement next to a perforated interval. Be sure that you have a good cement job and can segregate the pay before you fracture.

If the pay takes the fracture fluid without returning it, you should be cautious about fracturing other wells in the same pool. Probably the reservoir pressure is depleted and gravity is draining oil away from the well. Downdip wells may respond to fracturing in this case, however. *Well dies* . . . In this situation the reservoir may be nearly depleted but has sufficient gravity drainage toward the well to return the fracture oil even

Chances are that you know enough about fracturing to be pretty sure you'll be successful. But don't get too confident. You can't expect to fracture just any hole in the ground and get oil. And you'd better be sure the fractures are going to locate in your pay zone. Sometimes you may not be able to anticipate trouble. But if it occurs, a check of the following may tell you what's wrong and may help you to help your well.

hole or when perforations are clean, you should be cautious about fracture treating if breakdown pressure is excessively high. Possibly its strength is due to the formation being very tight. In this case, the formation may not give up enough oil to pay for the treatment.

Sandup . . . Where too much pay is exposed to the fracture fluid or permeability is high, the fluid may leak off as fast as you pump it in and no fracture results. Then when you follow it with sand you get a screenout and sand up the well. This may also occur with high-temperature formations which reduce fluid viscosity and increase leakoff rate. It is best to limit treatments to about 50 ft. of formation or to use a low-fluid-loss fluid to prevent this.

Sometimes the sandup may occur after a fracture is obtained. In this case, you have just exposed additional surface for the fluid to leak into. Fluid leakoff is fast, the fracture does not extend, and its width is narrow. Consequently the sand backs up and the well sands up. High injection rates, low fluid loss, and a small-grained sand will help this.

though it can't produce oil. However, the reservoir may also be extremely tight and might be helped by a larger treatment which will expose more flow area and reduce the pressure drop. There is also the chance that you formed an emulsion which is blocking flow. A surfactant treatment would clear this up.

Another possibility for a well dying is that the fractures entered depleted or barren sections. If the well has interbedded shale or permeability stratification, horizontal fractures may do no good. Plugging the initial fractures with sand or a temporary plugging agent and then refracturing may open up the productive sections. If you find horizontal fractures, you should attempt another breakdown with a low fluid-loss fluid to obtain vertical fractures.

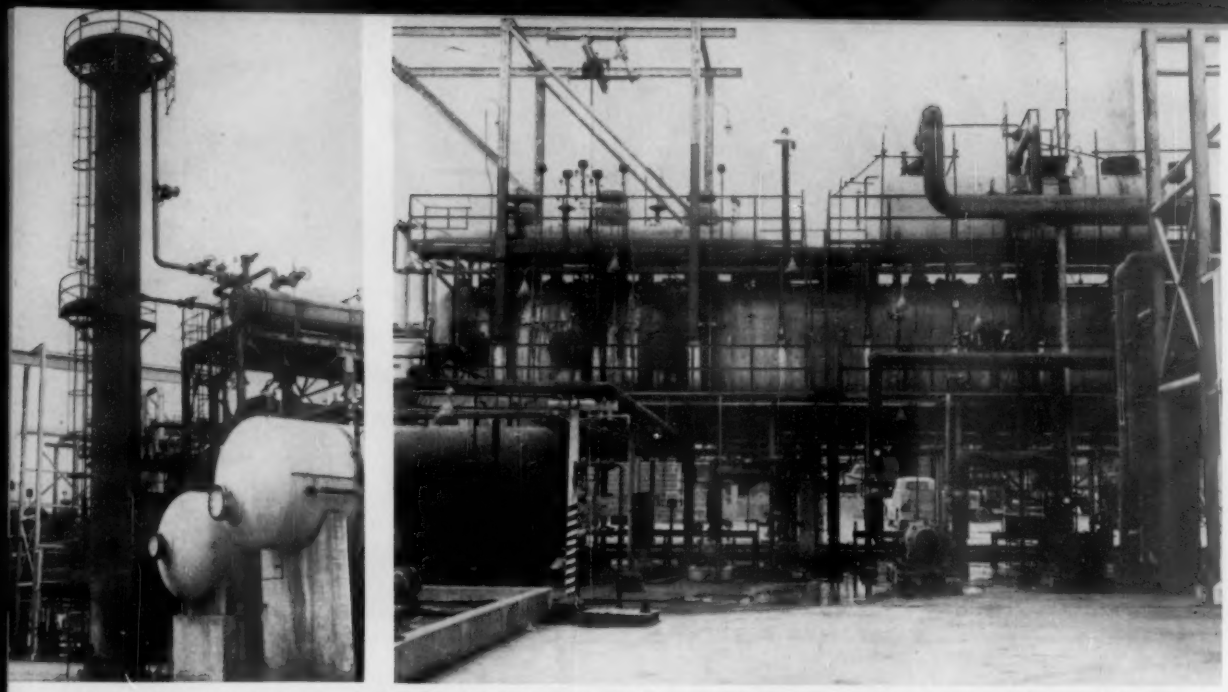
Fast decline . . . For a new well, this may indicate that the pool is small and not worth a completion. However, chances are you didn't get the fractures very far into the pay or the fractures have insufficient conductivity near the well bore. To get longer or more fractures you should use a larger volume treatment, taking advantage of fast injection and low-fluid-loss fluid. Use of temporary blocking agents or letting fractures sand up to get new breaks may help. Try minimizing the overflush and let treating pressure bleed off before opening up the well.

Water ratio up . . . This is probably a situation where you have created vertical fractures extending to the bottom water. Or did you have a poor cement job? Vertical fractures will increase conductivity in both oil and water zones but under the influence of the pressure drop into the well, the water cones upward through the fracture. When water reaches the oil zone it may tend to block the oil and possibly oil production will be decreased after fracturing.

In some cases, water production through fractures has been eliminated by a squeeze of a slurry of diesel oil and dry cement. The cement sets in the water zone and blocks water but allows oil production in the oil zone. This treatment has had only limited success, however.

To lessen the chance of water production, you should block the hole or perforate at least 20 to 30 ft. above the oil-water contact. When treating through perforations, be sure you have a good cement job. Even if you don't get a vertical fracture extending to water you may open up a channel down along the casing.

If the water contact is rising or the sand is thin, fracturing is risky. Sometimes very small treatments of only several hundred gallons will help the well in these cases without bringing in water. Slow injection rate has sometimes helped prevent fractures extending to water.

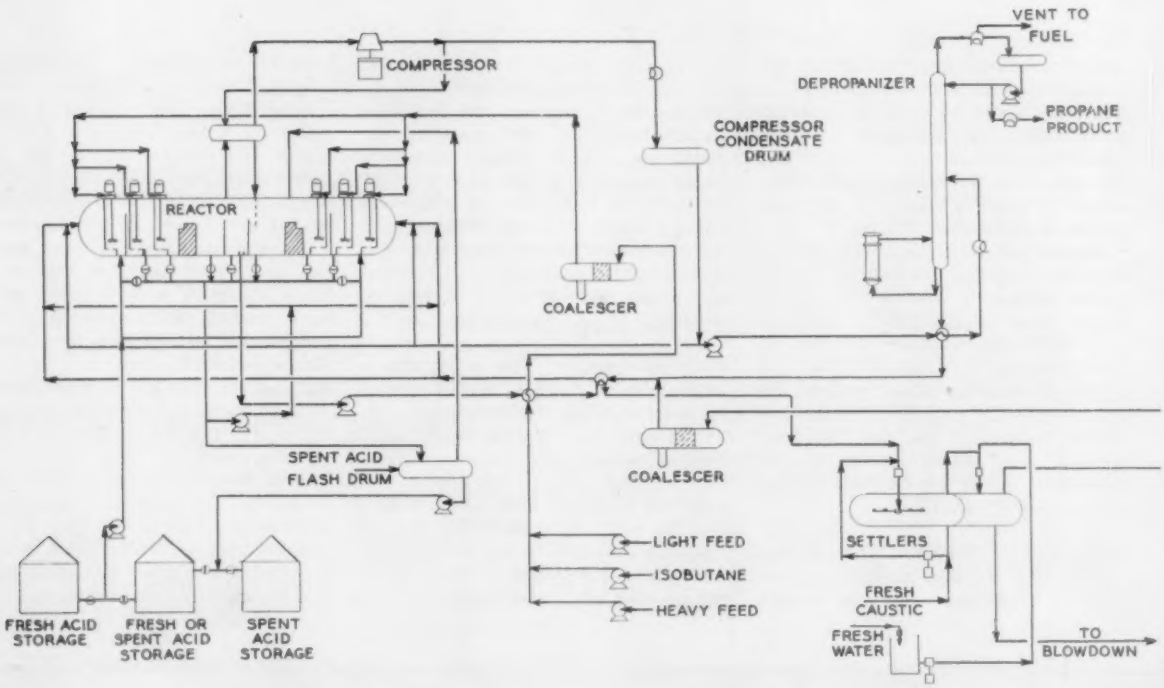


ALKYLATION REACTOR is single horizontal vessel (shown at right) with six reaction zones. The alkylation unit (at left) has operated successfully with wide variation in amylene feed.

Eastern States Alkylates Mixed Feed

Amylene content has varied from 7 to 18 per cent of the olefin feed, while propylene content has remained fairly constant at 26-29 per cent

by Larry Resen
District Editor



THE sulfuric-acid alkylation unit at Eastern States Petroleum Co.'s Houston refinery has these unusual features:

- The M. W. Kellogg Co. cascade reactor is employed in the form of a single vessel with six reaction zones, three on each side, with common effluent drawoff in the center.
- In its operations, Eastern States has charged varying feed stock to the unit. Amylene content has varied from 7 to 18 per cent of the olefin feed, while propylene content has remained fairly constant at 26 to 29 per cent of olefin feed. Higher unit throughputs accompanied by deeper cuts on the gas-plant debutanizer contributed to the high amylene content.

The unit has a design capacity of 3,500 bbl. of product alkylate daily.

Process Flow

At Eastern States, light and heavy alkylate feed streams are separately handled for convenience until they enter the charge header of the unit. Light feed is obtained from the depropanizer overhead condenser in the gas-concentration unit and heavy feed is debutanizer overhead from the same unit. Both of these streams and isobutane feed are commingled in the charge header and the combined stream passed through a coalescer before entering the reactor.

Cascade reactor . . . This is, in effect, two reactors in a single vessel. Due to the size of the unit it was felt practical to use a single oversize reactor rather than two separate and smaller reactors. Hence, the three cascade reaction zones are located in each end of the reactor. A settling zone is provided following the third reaction zone on each side, and a common effluent drawoff section is located in the center of the reactor.

The combined feed stream is split into six equal streams, each of which enters a reaction zone. Acid catalyst and isobutane-rich recycle and refrigerant streams enter the first reaction zone and pass in series flow through the following two zones to provide necessary excess isobutane. Cooling effected by an autorefrigeration system lowers the feed to 35°-45° F. at 5-15 psig. in the reactor. Heat-exchange surface and auxiliary refrigerants are not required with this system since the heat of reaction is removed by autorefrigeration in vaporizing a portion of the hydrocarbon stream at the reaction zone, thus promoting isothermal operation.

The series flow of the isobutane recycle and acid catalyst and the parallel flow of olefin-bearing feed create optimum reaction conditions of high isobutane concentration and a desirable high isobutane-olefin ratio with a minimum flow of external isobutane recycle.

Reaction products . . . Excess isobutane and other diluents in the liquid phase are separated from the acid in the settling zones. A portion of this acid is recycled and the remainder withdrawn to spent-acid storage following a pass through a flash drum. Reactor effluent is withdrawn into a settler where it is caustic-washed. From here it passes through fractionation equipment. Overhead from the deisobutanizer is recycled back to the reactor, and overhead from the debutanizer is withdrawn as butane product. A stream of butane from the plant Platformer is charged to the deisobutanizer.

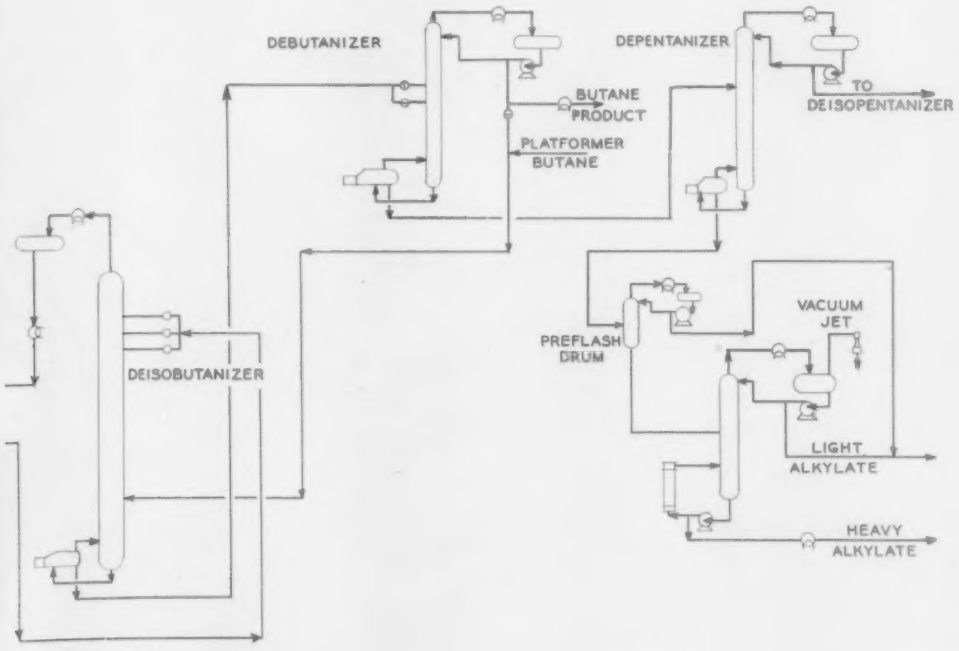
Overhead from the dependanizer, which was converted from an existing depropanizer tower, is charged to the plant deisopentanizer. In this column n-pentanes are recovered for blending to motor gasoline and isopentane is obtained for blending back with alkylate.

Dependanizer bottoms are flashed and then charged to the return tower where light and heavy alkylate streams are split out. Flash vapors recovered are condensed and blended with the light alkylate.

Refrigerant vapor . . . This results from removal of heat of reaction in the reactor. It is compressed, condensed, and the liquid returned to the reaction zone. The refrigerant is predominantly isobutane, with a fairly high propane content. Hence, a portion of this stream is diverted to a depropanizer tower where propane is removed from the system, and its bottoms recycled back to the reactor.

Operating Conditions

Operating conditions of the unit naturally vary from day to day and in accordance with the plant requirements. Hence, under some conditions, it has been necessary to dig deeper into the gas-concentration-unit debutanizer to up the feed throughput. Typical operating conditions have been selected for such a situation with high amylene content in olefin feed and also for a condition with low amylene content in the



PROCESS FLOW features the cascade reactor, which is in effect two reactors in a single vessel. Light and heavy alkylate charge streams are handled separately until they enter the charge header.

feed. The data were accumulated by taking the average of three composite samples in each instance. Each composite sample represented a week's run. The collected data are listed in Table 1.

In comparing the operating conditions, averages for the 3 weeks when amylene content was relatively high, are designated as Condition A, and averages for low amylene content in the feed are designated Condition B in the tables. When amylene content was high, charge to the unit was high; conversely, with amylene content low, charge was low. Hence, in the text, the conditions are loosely referred to as "high" and "low," respectively, corresponding to the above conditions. A substantial portion of the increased charge is due to additional amylene and isopentane picked up with it and charged to the unit.

In the A column we find amylenes to be 17.8 per cent of the total olefin charge and under B the amylene content is 7.0 per cent. Propylene concentration remained about the same, 28.9 per cent in A and 25.8 per cent in B. The difference was taken up by butylenes, which were 53.3 per cent of the total olefin feed in Condition A and 67.2 per cent under B.

Total alkylate yield under these conditions was 3,711 bbl. at high amylene and high charge rate, and 3,326 bbl. at low amylene and the lower charge rate. Per cent alkylate yield was a bit higher in the latter case, 66.2 vs. 62.5 for the higher throughput. The percentage light alkylate yield to total alkylate yield was approximately the same, 88.2 per cent at high charge rate and 88.7 per cent at the low rate. The ratio of light alkylate to olefin feed was much lower at the higher throughput, 1.45 as opposed to 1.62 at the lower throughput.

With a spent-acid strength of 92.9 and 92.7 weight per cent respectively for the high and low-charge operations, fresh-acid consumption averaged 1.53 and 1.26 lb. per gal. of alkylate for the two cases. Quality of the alkylate varied with the high charge resulting in F-3 octane number of 106.2 and F-4 performance number of 143.9, both with 4.6 cc. of lead. In the other case, the F-3 number was 106.5 and the F-4 number 146.1.

Acknowledgments

Cooperation of the management of Eastern States Petroleum Corp., Inc., in the release of this information and the assistance of E. L. Whittington, Jr., senior process engineer, is hereby gratefully acknowledged.

Reference

Mechanical Advancements in The Alkylation Process, S. R. Stiles, M. W. Kellogg Co., presented at annual Petroleum Mechanical Engineering Conference, A.S.M.E., Los Angeles, September 1954.

TABLE 1—EASTERN STATES ALKYLATION UNIT

	Condition A (higher amylene content)				Condition B (lower amylene content)			
Charge:	B/D	Per cent			B/D	Per cent		
Slop	73	1	....	....	58	1	....	....
Light feed	2,208	31.4	....	....	1,780	30.5	....	....
Heavy feed	2,317	32	....	....	1,874	32	....	....
Outside isobutane	1,753	24.5	....	....	1,200	20.5	....	....
C_4 to Deiso Twr. Btms. (Platformer butane)	797	11.1	....	....	935	16	....	....
	7,148	100.0			5,847	100.0		
Yields:								
Propane	792	13.3	....	....	787	15.6	....	....
Butane	854	14.4	....	....	914	18.2	....	....
Light alkylate	3,277	55.2			2,951	58.8		
Heavy alkylate	434	7.3	Total alky	3,711	375	7.4	Total alky	3,326
Mixed C_5's	583	9.8	....	....	....	....	....	....
	5,940	100.0			5,027	100.0		
Inspections:	Lt. feed	Hvy. feed	Total feed		Lt. feed	Hvy. feed	Total feed	
Total olefins in feed, bbl./day	1,181	1,076	2,257	....	945	845	1,790	....
Per cent olefins in total feed	31.6	....	....	....	30.7	....	....	....
	Lt. alky	Hvy. alky			Lt. alky	Hvy. alky		
Gravity, °A.P.I.	72.7	53.8	....	....	73.3	54.8	....	....
R.v.p.	5.5	....	....	....	7.2	....	....	....
Oct. F-3 + 4.6 cc. TEL	106.2	....	....	....	106.5	....	....	....
P.N. F-4 + 4.6 cc. TEL	143.9	....	....	....	146.1	....	....	....
Operating data:								
Spent-acid strength, weight per cent		92.9				92.7		
Fresh acid cons., gal./day		15,880				11,341		
Lb./gal. alky.		1.53				1.26		
Recirculated acid, g.p.m.		37				27		
Reactor temp., °F.		45				40		
Reactor press., psig.		99				91		
Isobutane in effluent, liq. vol. per cent		43.2				56.5		
Ratio: Lt. alky/olefins		1.45				1.62		
Lt. alky/total alky, per cent		88.2				88.7		
Charge inspection:	B/D	Liq. vol. per cent	Olefins, B/D	Per cent of olefin feed	B/D	Liq. vol. per cent	Olefins, B/D	Per cent of olefin feed
C_3=	629	8.8	629	28.9	433	7.4	433	25.8
C_3	703	9.9	....	....	677	11.6	....	....
iC_4	2,474	34.7	....	....	2,169	37.3	....	....
nC_4	1,115	15.6	....	....	989	16.9	....	....
C_4=	1,156	16.2	....	....	1,126	19.4	....	....
C_5	386	5.4	1,156	53.3	117	2.1	1,126	67.2
iC_5	666	9.4	386	17.8	313	5.3	117	7.0
	*7,129	100.0	2,171	100.0	*5,824	100.0	1,676	100.0

*Negligible amounts of C_2+C_6+ are disregarded, hence slight difference in total compared to actual charge.

Visco

CONSISTENTLY EFFICIENT OIL FIELD CHEMICALS

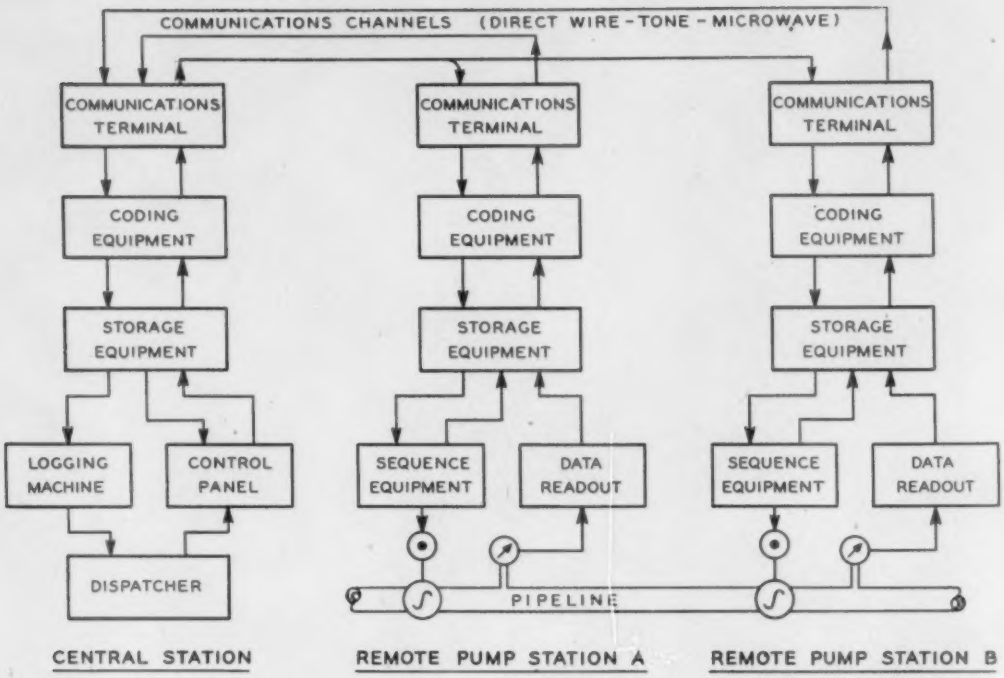


DIAGRAM OF REMOTE CONTROL of pump stations and data telelogging. Stations employing the new concept described in this article are in operation in Service Pipe Line Co.'s Wyoming system. Fig. 1.

DATA "TELELOGGING"

. . . A new approach to remote control in pipelining

by Arthur P. Jackel

FOR proper operation of any pipeline system, it is necessary that a dispatcher at a central office be kept informed of the operating condition of the equipment at the various pump or compressor stations along his section of pipeline, and of the line conditions pertaining to the product flow. This concentration of information at the central office enables a check on delivery schedules, efficiency of station operation, and a check on product loss. It also provides a means for expediting changes in delivery, thereby in turn allowing the pipelines to realize maximum revenue.

Conventional Methods

Conventional methods for a great many pipelines being operated at the present time involve manned pump stations, whose personnel take instructions from the dispatcher, and who supply information to the dispatcher via conventional communication channels at periodic intervals. Operations of pumps and valves are local, and the detection of operating conditions and faults, and the nature of the product flow, are also recognized locally. This information is then relayed to the dispatcher.

Due to the human time element, this involves an appreciable period between the time when readings are taken until all data are relayed to the dispatcher. Readings are usually recorded manually by two persons for analysis. Minutes, or even hours, might expire before appreciable deviations are recognized and it is known that an unfavorable operating condition exists.

In recent years, techniques from railroad centralized traffic-control and power-system supervisory control have been applied to the remote control of pipeline stations from a central point, the stations being separated by large distances. These techniques have enabled a dispatcher to supervise operations of such pump stations and to be kept informed as to the operating conditions of functions at those stations, as well as to detect faults that may develop.

However, in order to "know" what goes on inside that pipeline requires instrumentation. These measured variables are usually telemetered into the control point over separate communication channels, then called into the dispatcher by telephone where records of these readings are made for analysis.

Most telemeter values are presented "continuously" and are transmitted over separate communication channels. Sometimes, to economize on transmission channels, telemeter values are selected "on demand" or multiplexed. Numerous communication channels are required by a remotely controlled pipeline system, in order to supply the dispatcher at a central point with the facilities to have control of and to be constantly aware of the conditions along the entire pipeline system.

Since many pipeline companies resort to commercially leased communi-

Author is supervising design engineer, Union Switch and Signal Division, Westinghouse Air Brake Co., Pittsburgh. Paper presented at annual meeting, Instrument Society of America, New York.

CONSOLE from which single pump station is remotely controlled. Fig. 2.

Pipe Line	Time	Location Identity	Suction Pressure	Case Pressure	Discharge Pressure	Flow	Location Identity	Suction Pressure	Case Pressure	Discharge Pressure	Flow
2-	8:37	DA	102	1020	990	3680	CW	54	970	950	3670
2-	9:17	DA	88	1020	990	3670	CW	52	980	950	3660
2-	9:37	DA	82	1020	970	3650	CW	52	980	940	3670
2-	10:00	DA	77	1030	960	3650	CW	52	980	940	3660
2-	10:30	DA	51	1030	950	3650	CW	52	980	940	3660
2-	11:00	DA	50	1030	950	3650	CW	52	980	940	3660
2-	11:13	**DA**	**270**	**740**	**830**	**3500**	CW	52	1020	840	3660
2-	11:14	**DA**	**620**	**610**	**620**	**2800**	CW	52	1030	630	3600
2-	11:16	DA	580	500	580	2520	CW	52	1050	460	3100
2-	11:18	DA	570	480	580	2480	CW	52	1060	430	2420
2-	11:20	DA	580	240	580	2490	CW	52	1060	420	2450
2-	11:50	DA	580	010	580	2500	CW	52	1060	420	2490

Note: Bold Type above is Red Printout.

TELELOGGED RECORD sheet presents data in form for easy analysis. Fig. 3.

cation sources, it is to their advantage to find operational methods that require the minimum number of low-rate communication channels to supply all the necessary information. It is also to their advantage to obtain these readings "simultaneously" at all detecting positions and to present them to the dispatcher, preferably in a recorded form, as quickly as possible.

New Approach to Control

The story in this article presents a new approach to the method of supplying all the necessary remote controls, obtaining the operational and fault information, and the telemetered variables at the widely scattered remotely controlled pump or compressor stations, with the minimum of communication-line facilities. It also describes a system for obtaining this information within a period of seconds, and to automatically "telelog" pertinent information for immediate and future reference.

At most, a communication channel is assigned to each station, including the central station, thereby obtaining full-duplex operation. Suitable code-control equipment is selected to operate over these channels to carry the coded intelligence for control and information on pipeline operation. If the code-control equipment selected is below 20 pulses per second rate, the cost of the necessary communication channels is at the minimum expense should they happen to be leased circuits. These can be physical wires, tone channels, or microwave.

Of course, it is quite generally known that code-control systems can be applied in numerous cases to remotely controlled pipeline stations to start and stop pumps or compressors, to operate valves, etc. It is also known they can provide means to inform the dispatcher of the operating conditions of these pumps or compressors and valves, to detect and warn of machinery faults causing automatic shutdowns, etc. However since the functional operations and fault detections call on the system to operate at infrequent intervals ordinarily, the code-control equipment and communication channels associated with these functions are thus idle most of the time. Therefore, it appears reasonable that the same equipment should be pressed into usage to keep the dispatcher informed of necessary operational information or data.

New concept . . . Herein, a new concept is born—and that is, to supply information only when such information bears significance. Continuous operational information on any variable simply for monitoring operations has no more value than bringing in the information only once each time the variable changes to a new valve, except possibly to assure the dispatcher that he has a check on the monitoring facility. So long as the variable remains at the same value, there is no significance to bringing in the same reading continuously over and over again for a long period of time as compared to bringing in that reading only once, and then not again unless the reading has changed to another new value.

Therefore, if this variable can be sensed when it changes in value, and it can be translated into such form as to be transmitted over the same code equipment and utilize the same communication channels to the central station as the operational functions, these variables can then be displayed either visually, charted, or typed—in other words, telelogged. These measured variables are such readings as suction, case or discharge pressure, product flow, engine r.p.m., automatic controller set point, etc. Telelogging consists of displaying the data, preferably by typing it on a log sheet, so the data can be presented for immediate use for analyzing present operating conditions, as well as for future reference without the manual handling to record it.

Fig. 1 shows a typical remotely controlled pipeline system, having stations

Dowell engineer controls the powerful Allison with remote panel.

MUD ACID

gives frac jobs a running start

For best results, fracturing fluid must enter the pay zone with enough velocity to carry its cargo of sand deep into the formation. Often, when the sand-laden fluid enters a "mudded off" formation, fluid velocity is decreased and the sand is "screened out" in the well bore. The result may be a poor fracturing job.

This situation can be avoided by using Mud Acid as a spearhead for fracturing. Mud Acid, a combination of hydrochloric and hydrofluoric acids, has the ability to dissolve or disintegrate drilling mud materials, such as bentonite. This permits fracturing fluids to enter the formation at reduced pressures and higher velocities. It also provides better distribution of the sand and increased permeability in the critical area surrounding the well bore.

Versatile Mud Acid is also used to open mud-fouled screens and liners and to free stuck drill pipe. It is an effective spearhead to clean up the well ahead of squeeze cementing operations.

For more information on the many uses of Mud Acid, call any of the 165 Dowell offices in the United States and Canada; in Venezuela contact United Oilwell Service. Or write to Dowell Incorporated, Tulsa 1, Oklahoma.

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"Herein, a new concept is born—and that is, to supply information only when such information bears significance."

A and B remotely controlled from a central station. Controls to operate pumps, valves, etc., at stations A and B can be transmitted from the central station. Likewise, operating information on pumps, valves, alarms, etc., are provided to the central station from stations A and B.

All these controls and indications are provided by means of code - control equipment and in this case three half-duplex communication channels. When the code equipment is idle for operational purposes, pipeline data is brought into the central office by this same equipment to "log" data either when pipeline conditions change or at regularly clocked intervals for verification.

Of course, such information is pertinent only if the transmitted data are accurate. A solidly designed and dependable code - control system should be chosen for the purpose, which has a high degree of reliability and relatively low maintenance requirements. Safeguards should be provided in the equipment so that it is capable of recognizing correct code patterns received over the transmission circuit.

Since remote control of pump or compressor stations and information on the operating conditions is a generally known art, this article will bypass discussions on those operations. It will deal principally with the new concept of obtaining and presenting data on the product flow within the pipeline, which is now customarily telemetered and telephoned to the dispatcher and then manually logged.

Fig. 2 shows a photograph of a typical control console, which is located at the central office for remotely controlling a single pump station. On the panel are located push-buttons for starting and stopping a pump unit and other auxiliary controls. There are also indication lamps which show the operating conditions of the pump unit, the position of the valves, the alarms for the machinery and station faults, etc.

If there are more units located at the pump station, and if there are more pump stations located along the pipeline system, more such panels are required by the control console. In front of the console is located an electric typewriter, on which data is automatically "telelogged." A clock located on the console supplies the typewriter with the time of day when the readings are taken.

All of the operations are performed and all of the data are stored in the system under consideration by low-voltage, direct-current type of relays.

Typical "telelog" sheet . . . Fig. 3 shows a sample of a typical telelogged record sheet. This record sheet has a fixed format. Notice that each reading appears in a specific column and does not need to be identified. A master heading scale can be placed at the top of the sheet in case any new persons reading the sheet needs to identify the columns. If there are several pipelines which are served by the remote-control pump station, the first column in the line of data represents the pipeline number, the second is the time of day in international form.

In this example, the next column is the identity of the first remotely controlled pump station (which can be represented by one or two letters) and the following columns represent such values as suction pressure, case pressure, discharge pressure, and flow rate at that location. The next column is the identity of the second pump station, then the suction, case and discharge pressures, and flow for that location, and so forth across the page. When several pipelines are served by each pump station, it may be desirable to have several typewriters, and to assign one typewriter to tabulate the data for a specific pipeline system.

Notice how convenient it is to analyze the operating conditions from this telelog sheet. For instance, the seventh column represents the flow rate at the first location. Scanning down the column shows exactly the progressive behavior of the product flow. Any appreciable variation is immediately noticeable, and the dispatcher can then determine whether corrective measures need to be taken.

Printout initiation . . . Printout of data at the central station is initiated under three conditions. First, if everything is running smoothly, a clock programer can call for a printout at regular timed intervals, say every half hour after the last information has been received. Second, the dispatcher can request a reading "on demand" any time he wishes a check on the data by operating a "Telelog Call" push button. Third, immediate printout is automatically initiated when information is received at the central station that appreciable deviation has taken place in some variable at a remote pump station which is greater than a preset amount.

In any of these cases, the printout program is the same, and that is to issue instructions to all of the pump stations along that pipeline to rack up the readings on all of the variables simultaneously, and then to report this information to the central station one reading at a time in an orderly manner. Then length of time required to report all of the information will vary depending on the code system, the number of variables, and the number of pump stations. A reasonable yardstick is to consider about 10 to 12 variables being reported in each minute, but this time can be shortened if necessary by slight additions of equipment.

Data readout . . . To obtain data on any specific variable at a pump station (such as pressure, flow rate, engine speed, or the like), it is first required that some form of a suitable transducer be provided that can be used to measure the variable, and to convert that measurement into a means for driving an indicating instrument. This instrument should also be capable of delivering data in digital form to the code system.

These digital outputs are used in decimal binary combinations and their electrical signals characterize the associated code for transmission to the central station. If the variable is a three-digit number, 12 output circuits are required to supply the binary bits to signify the numerical value from 0 to 999. Four of the bits represent the 100 values, four bits represent the 10 values and four bits represent the unit values.

The accuracy of the reading is dependent upon the resolution of the instrument and its digital readout, as the code transmission should not introduce error. The code transmitted will correspond to the electrical output combination that is supplied to the code equipment in digital form. The digital combination must be supplied as signal outputs in such a manner as to avoid any ambiguity in the reading. If the instrument is in motion at the time of the readout, either the instrument is stopped temporarily or the reading is extracted, stored, and locked until the code is transmitted.

When the code is received at the central station it is preferable to translate its form so that the information is placed into storage in weighted decimal binary form. This means that the four bits which represent each digit are assigned weighted values such as 1, 2, 4, and 8. Thus, the sum of the weighted values of a combination adds to the number which it represents, for example, $1 + 2 + 4 = 7$.

These data now in storage can then supply the necessary outputs to provide the telelog. In addition to operating

"This system can be used on a variety of pipeline layouts, including gathering systems, tank farms, and offshore applications."

conventional visual displays on the panel, these storage outputs can operate recording chart instruments, tape-punching machines, or the typewriting equipment which is herein being described as the primary telelogging instrument.

Data program . . . As mentioned before, printout on the electric typewriter is controlled by a programer which is located at the central station. This programer issues instructions to all the remote pump stations when to rack up readings, on which pipeline readings are to be taken, when to report in an orderly manner, and when to release this rackup. This same programer also selects the typewriter which will be called upon to print out the data, and prints the time of day. As fast as the data come into the central station, this programer places these data on the selected typewriter according to the established format, of which Fig. 3 is a representative sample.

In case communication facilities should become faulted between the central station and any remotely controlled pump station the programer is arranged to bypass that portion of the data printout. In that event, the data from all the good stations continue to be recorded in their proper columns.

Automatic initiation . . . The central station can be requested to call for a data printout from all locations whenever information is received from one of the remote stations that a particular variable has deviated by more than a preset amount. An automatic "watchman" can be supplied at each remote station for certain variables, such as discharge pressure, flow engine speed, etc. This device is monitoring equipment of the computer type.

It is not necessary to provide such a monitor for all of the variables at a given pump station, as generally several variables are so interrelated that whatever caused one variable to change in value will also cause several others to change. Therefore, only a certain key item needs to be supplied with a monitor. When a printout request is initiated by a monitor at one location, all the data for a system are reported.

This automatic watchman operates from a separate sensing device driven by the indicating instrument, and it counts each unit change from the previous reading used as the reference point. As the variable deviates away from this reference point, either upscale or downscale, this device adds the units of deviation into the counter. As the variable reverses itself and starts to return toward the reference point, this device subtracts the units of deviation from the counter. Thus, the ordinary fluctuating conditions which are quite natural in pipeline operation never rack up sufficient count to initiate a printout request.

However, when the deviation continues in the same direction and adds up to the given preset amount, this device recognizes the excessive deviation and sends a warning to the central station. This results in the programer calling for a complete system printout of all data. Having reported a set of data, a new reference point is established, from which new deviations are monitored.

This watchman can be equipped with a timing device to sense whether these deviations occur at a slow or at a fast rate. Larger amounts of deviation may be permissible if the rate is slow, as these may be the result of conditions which bear attention but are not necessarily alarming. However, rapid deviation may be the result of an "upset" in the system and should be reported immediately. Therefore, a smaller amount of deviation which occurs at a fast rate can be recognized by the monitor and a warning sent to the central station.

This upset warning can also cause an alarm to sound at the central station, and to pin point the upset condition by printing that portion of the line of data on the log sheet in red figures, as illustrated in Fig. 3. If this upset continues, repeated printouts on the log sheet will show the existence of this condition in red figures on successive lines. After the upset ceases, and until conditions settle down, several closely spaced printouts are provided, such as a printout every 2 minutes for the next 5 to 10 minutes. Thereafter, the regularly clocked programing takes over again.

"Once you start talkin' to yourself, it's time to quit this job."

Conclusion

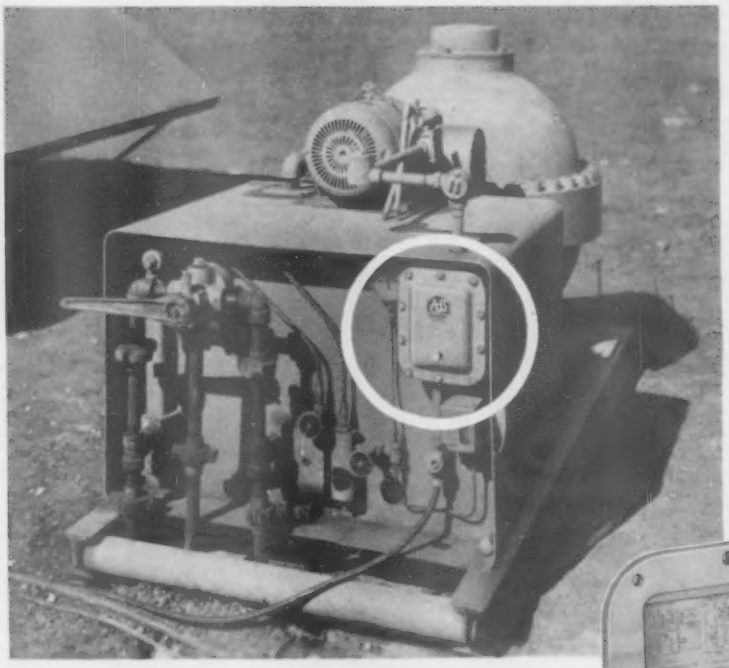
The advantage of the method of operation described above to a pipeline company is that it reduces the work load for the dispatcher so that he is available to analyze situations and plan operations more efficiently. Data are automatically logged for the dispatcher at regularly timed intervals or at his request so long as everything is operating smoothly along the pipeline system.

Now picture an upset occurring as a result of a pump unit being shut down due to a fault developing, or as a result of a break somewhere in the pipeline and a sizable portion of the product is being dissipated. In a matter of seconds the nearest automatic watchman senses that this is occurring and transmits this information to the central station, where an alarm sounds to attract the dispatcher to the situation that requires his immediate attention.

As he approaches the control console, a system typewriter starts to print a line of transient data and in a few seconds shows the status of conditions on the entire pipeline system. A portion of the line is printed in red to show exactly what location is primarily affected at that instant and which values require immediate analysis. Then at timed intervals the data will continue to come in so long as the upset condition continues and until the condition returns to normal.

This system can be advantageously used on a variety of pipeline layouts, including gathering systems, tank farms and offshore applications. The code control system is flexible and expandable and operates over any transmission medium—d.c. line pair, carrier, or microwave—and offers utmost reliability with extremely low maintenance from initial startup. With this system, whose basic principles have been thoroughly proved in service for many years, more efficient dispatching and more effective control of throughput at reduced cost will be provided.

End.



The Sign of
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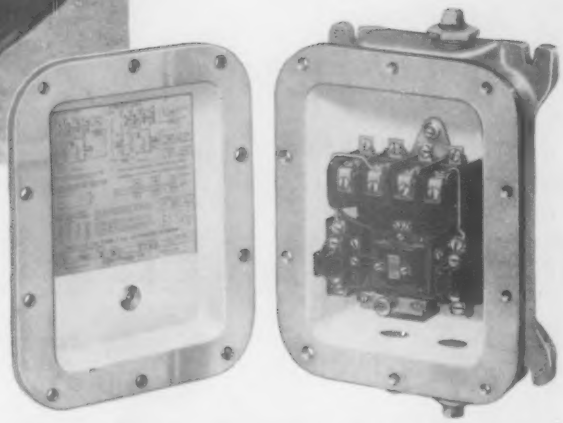
MOTOR CONTROL



A typical Allen-Bradley explosion-proof solenoid starter with cover removed to show machined flanges of the cast iron cover and base. Starter shown is Size 1 unit with maximum ratings of 5 hp, 220 v; 7½ hp, 440-550 v.

ALLEN-BRADLEY

Maintenance Free Starters

The Allen-Bradley automatic starter shown above on the hydraulic pump of a Hydrill pressure control unit is mounted in a NEMA Type 7 explosion-proof enclosure. The heavily bolted covers are something of a chore to unbolt and bolt just for contact inspection.

Fortunately, Allen-Bradley solenoid starters are good for millions of trouble free operations; the silver alloy contacts are always in perfect operating condition. The solder pot type of overload relays is not affected by time or atmospheric conditions. Thus, the motor remains reliably protected against overloads. You can install Allen-Bradley starters . . . and forget them.

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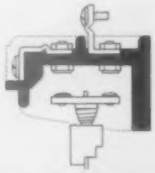
SILVER ALLOY CONTACTS

The silver alloy contacts used in all Allen-Bradley solenoid starters require no cleaning or dressing. Hence, the contact life is lengthened and switch failures, due to faulty contacts, are eliminated.



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The use of double break contacts does away with flexible jumpers or shunts. Being enclosed in the arc hood increases the disrupting capacity of the contacts. There is no contact maintenance.

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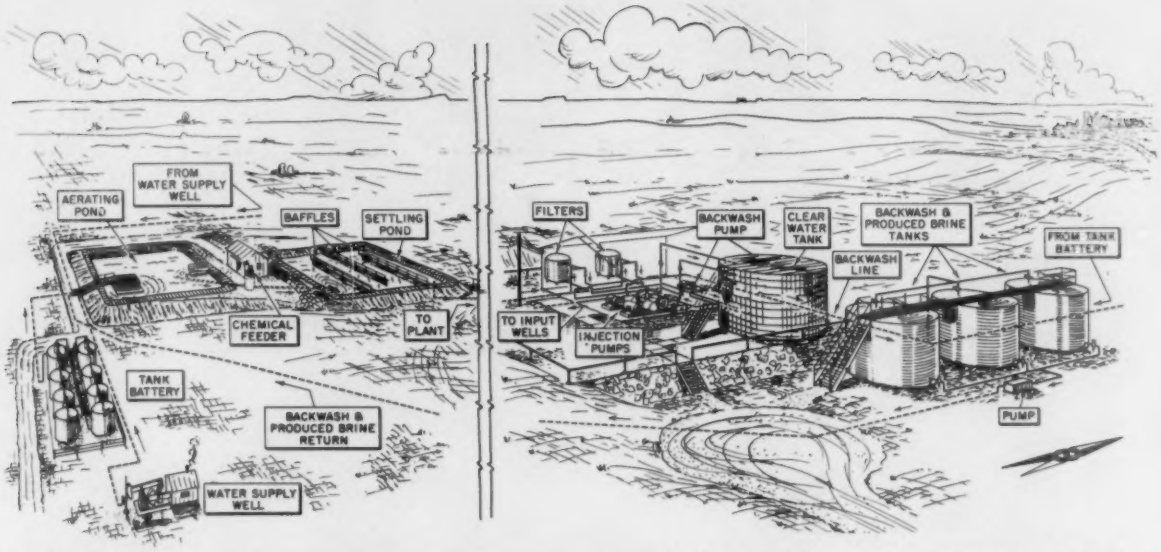

DOUGLAS WATER at 1,400 ft. provides most of the water for flooding the Bartlesville sand at this project. Water is aerated, chemically treated, and filtered.

Water Flooding in Butler and Greenwood Counties, Kansas—5

Ohio Oil's Bryden-Ladd Project Treating Plant

by Jack P. Powell

WATER from Ohio Oil Co.'s Bryden-Ladd Project treating plant is used to flood 537 acres of Bartlesville sand at 2,400 ft. The pay sand has 18 per cent porosity, 19 to 50 md., and is 50 ft. thick. Estimated oil saturation at the beginning of water injection was 48 per cent.

Source and Treatment of Water

Four wells, completed in the Douglas formation at 1,400 ft., provide water for the flood. One of these wells was previously an oil-producing well and later served as an input well for a dump flood. The other three supply wells were completed with 7½-in. casing set at the top of the formation and cemented to the surface. One of the supply wells is equipped with a 37.5-hp. submersible electric pump, and the other three are equipped with rods and tubing and are pumped with heavy-duty pump jacks. Power for each pump jack is supplied by a 40-hp. diesel engine. The water-producing capacity of the wells ranges from 1,000 to 1,500 bbl. daily, but present demand does not require continuous operation of the wells.

Author is petroleum engineer, U. S. Bureau of Mines, Bartlesville, Okla. Data from USBM information circular.

The water-treating and pumping equipment is shown in the sketch. Produced brine and supply water enter at the top of a tray type of aerating tower, about 20 ft. long and 7 ft. wide, constructed of redwood and supported by 4½-in. pipe cemented in the bottom of the aerating pond. Three perforated and baffled trays about 2 ft. apart provided a surface to disperse the water and permit hydrogen sulfide and carbon dioxide to escape and iron compounds to be oxidized. The aerating pond is 100 ft. long by 75 ft. wide at the ground level, has graded slopes (3:1) and is lined with an asphaltic sheet material to prevent seepage.

Chemicals used . . . From the aerating pond the water flows through a 7-in. conduit in the middle of the earthen separating wall into the settling pond. On the separating wall just above the conduit are two dry chemical feeders, one of which continuously adds lime to the water at the rate of 6 lb. per 100 bbl. of water as the water passes through the conduit and the other adds 17 lb. of Nalco 680 daily.

PRODUCING

The settling pond is about 140 by 115 ft. at water level, but the walls are sloped inward. The pit is also lined with an asphaltic sealing compound to prevent seepage of the brine. Three large baffles have been constructed in the pond to prevent the water from channeling through it and to permit adequate time for the solid products of chemical reactions to settle. The water from the pond enters a 3-ft. vertical section of slotted pipe and flows by gravity through the filters.

Filters . . . Two closed-type rapid filters 8 ft. in diameter by 5 ft. in length filled with graded gravel and sand are used. Water flows into a wooden, 500-bbl., clear-water tank that supplies water to the injection pumps under a hydrostatic head of 8 ft. Treated water used to backwash the filters flows into the backwash water tanks.

Two pumps powered by 75-hp. electric motors force the water through the distribution lines to the wells at a plant pressure of 1,040 psi. A small chemical pump has been connected into the discharge of one of the pumps and the injection of a corrosion inhibitor is being tested.

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Simple, two-wire electrical hookup with fast, positive shut-off eliminates need for secondary air or gas power source.

H-3 Type Hydramotor Valve. Carbon steel body for pressures to 1000 p.s.i. Two-wire electrical circuit operator is weather, explosion-proof. Fail-safe, fast closing.

For automatic shut-off, three-way control or tank switching operations, no other motor valve or controller can match the benefits from installing General Controls Hydramotor valves on remote tank and feeder line applications.

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No. 1 Hydramotor valves are simple, rugged electro-hydraulic valves that operate on simple, two-wire electrical circuits already available. No additional power source is necessary.

No. 2 Hydramotor valves are *all-electric*, provide interlock without additional valves, yet they *fail-safe* on power interruption.

No. 3 Hydramotor valves completely eliminate the need for extra piping, tubing, strainers, dryers and pilot valves. Overall system cost is much, much lower.

No. 4 Hydramotor valves are simple, trouble-free. Maintenance costs are low . . . eliminated are worries about frozen control lines, leaks and blocks in lines and pilot valves.

No. 5 Hydramotor valves laugh at weather. Desert heat or arctic cold, under conditions where attendants couldn't get to a manual valve, they're on the job 365 days a year, unattended and trouble-free.

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One reason for this is our method of manufacture. Every joint is formed from flat rolled steel, carefully checked for uniform thickness from edge to edge and end to end. Both surfaces are visually inspected to make certain they are free from valve-clogging scale and trouble-causing defects. The pipe is then formed and permanently joined by the Electric Resistance Weld method—pioneered by Republic Steel.

High ductility is built in to assure smooth, uniform bends. So is uniform high-yield strength to permit the building of high-pressure lines. And all joints are pressure-tested to make absolutely certain of complete dependability in service.

You'll save installation time and money—be sure of a quality job when you specify Republic Electric Resistance Weld Line Pipe. It's available in sizes 2⅜" through 16" O.D. Republic also makes big-diameter Fusion Weld—sizes 24" through 30" O.D., Continuous Butt Weld in sizes ⅛" through 4" nominal, and Plastic Pipe in flexible and semi-rigid types.

If you have a transmission, gathering, distribution, and product-line problem, call us. Or send coupon for descriptive literature.

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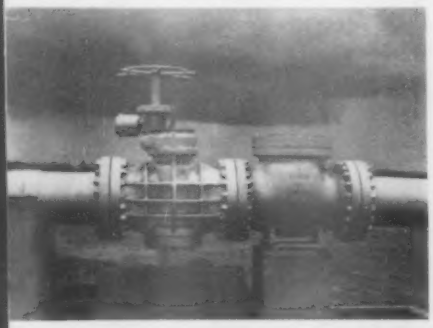

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FIXED-DECK SUBMERSIBLE BARGE just commissioned by Delta Offshore can drill wells to 20,000 ft. in water 25 ft. deep. Fig. 1.

On new submersible barge . . .

Delta Offshore Drives A.C., D.C. Generators Together

by Ed McGhee
District Editor

LIKE other electric rigs, that on Delta Offshore No. 1 drives drilling machinery with d.c. motors which get control from a.c. current. Unlike other rigs, however, this one uses the same engines to drive the a.c. generators that drive the d.c. generators. Since a.c. also runs all barge auxiliaries, this arrangement gets the greatest flexibility while keeping total installed engine horsepower to a minimum. Moreover, there is less chance that power will ever be lost for lack of a.c. control power.

Fig. 1 shows the new submersible barge, the Delta Offshore No. 1, recently commissioned by Delta Offshore Drilling Co. and now on its first well for The California Co. in Bay Marchand. This vessel can drill wells to 20,000 ft. in water up to 25 ft. deep. In addition, it is among the few mobile offshore units whose drilling machinery is entirely diesel-electric driven.

Delta Offshore does not rely on a separate light plant to run auxiliaries and furnish control current for the d.c. motors. Instead, it has made a.c. auxiliary and control generators an integral part of the power plant. A.c. generators are mounted on the same skid with d.c. generators and run off the same engine. This arrangement keeps the number of engines to a minimum and gives added flexibility to both a.c. and d.c. power systems.

Moreover, the generator arrangement makes each power skid self-sufficient so that power for normal drilling should never be lost because of failure of any one engine or generator. Even with one engine alone, there is enough power for emergency hoisting or pumping.

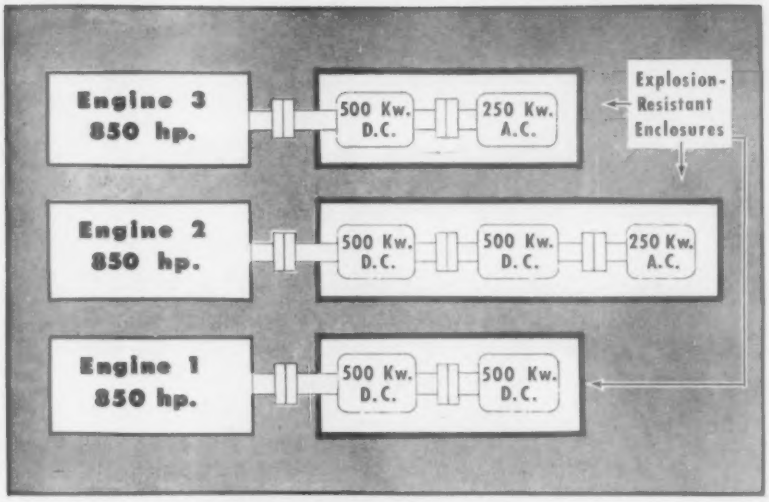
Two and three generators . . . Fig. 2 shows the arrangement of the power plant in Delta Offshore No. 1. Each of the three engines is an Alco Products six-cylinder, 9 by 12½-in., 850-hp. diesel. No. 1 engine drives two d.c. generators in tandem. No. 2 engine also drives two d.c. generators but has an a.c. generator in tandem as well. On the No. 3 engine skid, there is a single d.c. generator in tandem with one a.c. machine.

All the d.c. generators are G.E. 500-800 kw., 600-800-volt machines with inverse-compound winding. Both a.c. generators are G.E. 250-300 kw., three-phase, 60-cycle, 900 r.p.m. machines. To prevent variation of a.c. frequency more than two cycles per second, both engines that drive an a.c. generator have special engine-speed governors as well as special horsepower-output division.

With this arrangement of generators and engines, all jobs on the rig can be performed with only two or three engines in the power plant operating. And, whenever possible, operation of the engines will be staggered so that there will be dependable standby for emergencies. However, the rig could continue rotating and circulating or "ease" out of the hole if one engine were operating alone.

Four d.c., rest a.c. . . . There are only four d.c. motors on the Delta Offshore No. 1; two of these power the draw works and there is one on each of the two mud pumps. These four motors are indentical and are G.E. 600 to 800-hp., 900-r.p.m., shunt-wound machines.

To the Unit Rig U-1220 draw works, the two motors deliver 1,700 hp. continuously or a maximum of 2,200 hp. on an intermittent basis. Each of the pumps, D-700 Emsco's, will have 700



POWER GENERATORS operate in tandem from diesel engines. D.c. motors are controlled by a.c. current. A.c. runs all barge auxiliaries. Fig. 2.

hp. available from its motor. Rotary power will come off the draw works.

All the remaining motors on the barge are a.c. This includes motors for: water and fuel pumps; ballast pumps; fire and special-service pumps; refrigeration and air conditioning; air compressors; shale shakers; anchor-line winches; and mud mixers.

Made explosion-resistant . . . To cut the danger of explosion and fire resulting from well gas, Delta Offshore has enclosed all the generators and all the d.c. motors. This enclosure—shown on generators in Fig. 3 and on the draw-works motor in Fig. 4—is airtight. And, an air-circulating fan inside the enclosure maintains a slight positive pressure to keep any gas from entering.

Each enclosure around a motor or generator has a water-to-air heat exchanger so that heat can be removed. Also each enclosure has a manually operated purging valve that will allow a change of inside air when there is no explosion hazard.

This practice of enclosing motors and generators compares with past practice of using water-cooled motors or of piping in cooling air from a remote location.

The barge . . . Designed by Friede & Goldman, Inc., and built by Avondale Marine Ways, New Orleans, the Delta Offshore cost less than $2,000,000 rigged up ready to drill. The vessel is the self-stabilizing type which is well suited for soil conditions in the location and depths in which it will work.

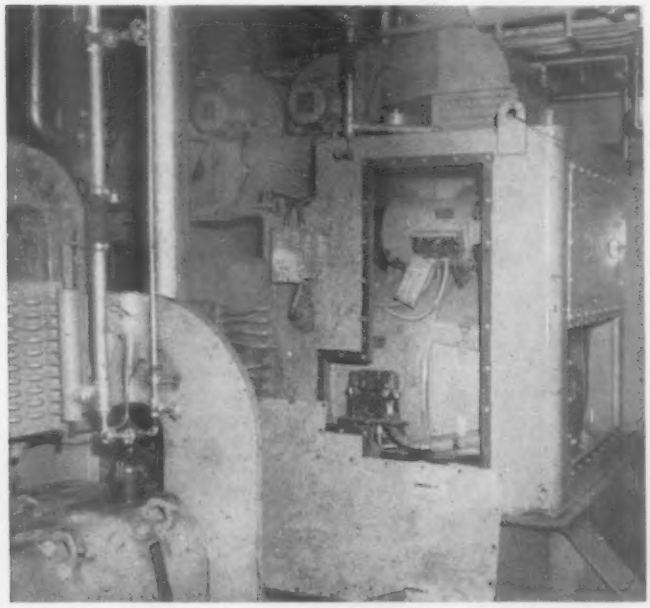
When the hull is lowered or raised, it is stabilized by four recessed pontoons operated hydraulically by the mud pumps. Drilling and machinery decks are supported on fixed columns, secured to the hull. Adjustable fenders supported by vertical steel bridge-type wire cable protect the structure and tugs, supply ships, or barges which moor alongside.

Fuel oil, drilling water, and potable water are stored in the hull. The hull has a rake-shaped bow section for efficient towing; the hull itself has full antiscouring design with skirts fitted entirely around it.

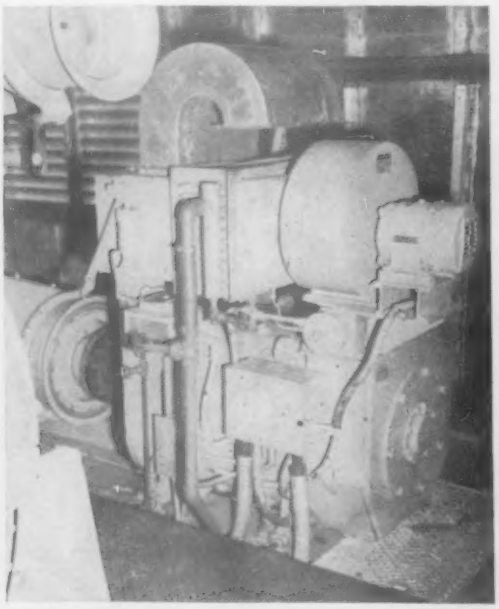
Deckhouse and helicopter deck are of plate aluminum; main supporting columns and structurals are of a high-tensile alloy.

Acknowledgment

Credit for assistance in the preparation of this article is due A. F. Landers, diesel-electric consultant of New Orleans, who designed the rig, and to Dave Vasser, president, and H. A. Broughton, drilling superintendent, of Delta Offshore, New Orleans.

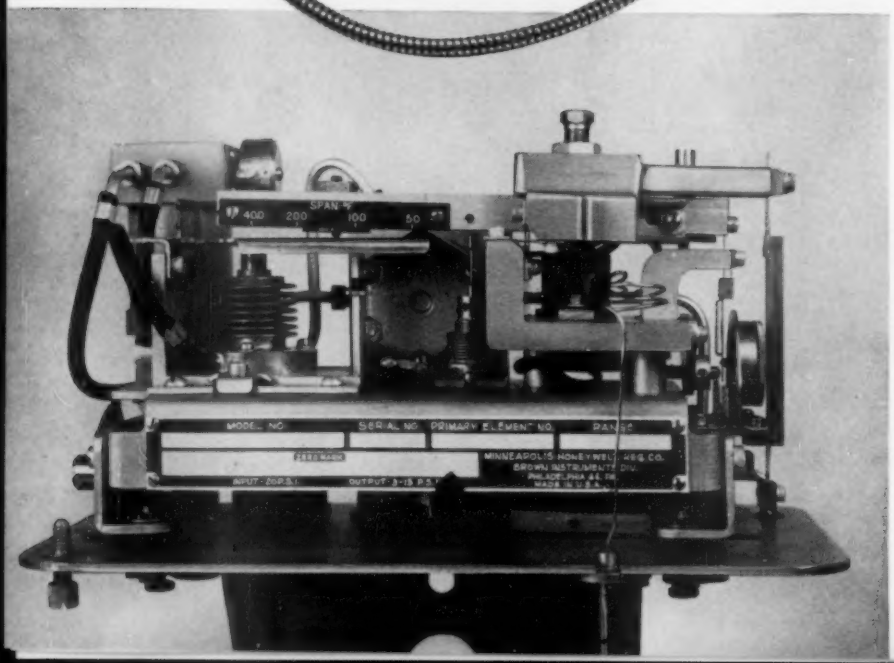


EXPLOSION-RESISTANT case around generators guards against well gas being ignited. Note cooling coils and air circulating fans to remove heat when the case is closed. Fig. 3.



MOTOR COOLING is also provided by a fan and coils circulating water. Motor enclosure is under slight pressure to keep out gas. Fig. 4.

You can mount the transmitter at the point of measurement, either indoors or out. A sturdy, weather-proof aluminum cover protects all working parts and adjustments.



Interior view of the transmitter shows the accessibility of all parts. Span and zero adjustments are easy to make, and no changes of parts are required.

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First in Controls

by W. L. Nelson
Technical Editor

QUESTIONS ON TECHNOLOGY

Yields in Catalytic Cracking

Although there is much literature on catalytic cracking, we have no way to estimate yields. What have you published on this?—M.F.T.

Nothing has been published by this department since the early days of catalytic cracking,[1,2] except in a recent issue[3] which discussed the effect of the characterization factor of the feed stock on yields. Meanwhile, much good information has been published (see references) and this has been correlated in Fig. 1 on this page. Especially comprehensive are the papers of Schall, Dart, and Kirkbride,[4] and of Olsen and Sterba[5] but many references provided useful information.

At higher conversion levels, it was possible to indicate the effect of recycle ratio (cycle stock over fresh feed) in terms of the single-pass conversion capacity. Thus a plant that has capacity to crack to a conversion of only 47 per cent on a once-through basis does not respond as well to recycling as a plant that has the capacity to crack to a 62 per cent conversion (once through). This could be indicated for coke and debutanized 400° end-point gasoline yields, but data were not sufficient for making the same distinction for the dry gas (propylene and lighter) or the B-B cut (all four-carbon-atom materials).

In general, the moving-bed processes utilizing synthetic beads produce less coke (7-10 per cent) than the amount shown in Fig. 1, whereas the fluid process produces more coke (11-14 per cent). The amount of gasoline produced by all processes is much the same (slightly less by the fluid process, but the fluid-process gasoline has a slightly higher octane number. Likewise, the amount of dry gas produced by the moving-bed processes is lower than indicated in Fig. 1 by about 6-9 per cent and the fluid-process yield is higher by about the same amount. The fluid process produces a larger percentage of olefins in the B-B cut (and other gases) but 7-14 per cent less B-B cut is produced than indicated in Fig. 1 whereas 7-12 per cent more is produced by the moving-bed processes. It is obvious that each plant behaves different from the average plant or the better-than-average plant contemplated in Fig. 1. Note especially that the above comparisons were based upon the same percentage conversion and that each type of process actually operates at its own best amount of conversion. Thus, the above should not be interpreted to mean that one process is better than another, because many other factors such as catalyst consumption, cost of operation, ease of circulation, etc., are the vital factors. The yields given here are for 11.8-12.0 characterization factor straightrun charge stocks, and more carbon (and less gasoline) is produced from excessively high-nitrogen or high-sulfur stocks. The general effect of characterization factor on yields was discussed on a recent issue of this page.[3]

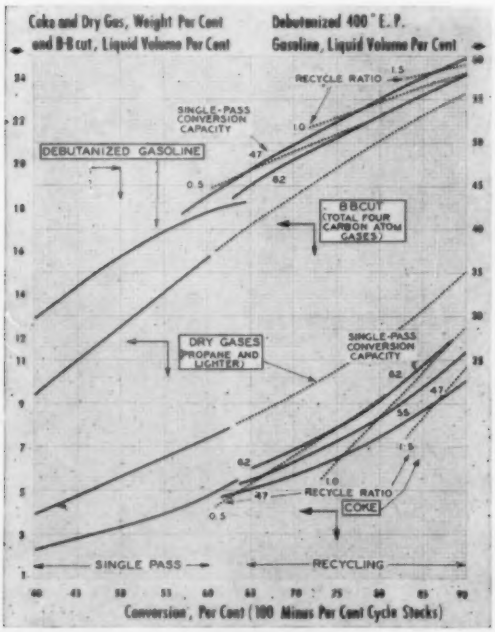

Fig. 1—Approximate yields in catalytic cracking of 11 and 12-characterization-factor feed stocks.

The yields of gases can be estimated from the following:

	Per cent	Range
Butylenes in B-B cut, volume per cent:		
Fluid	40	21-49
T.C.C.	35	17-42
Isobutane in B-B cut, volume per cent:		
Fluid	52	42-68
T.C.C.	51	
Propane-propene, weight per cent dry gas:		
Fluid	68	61-85
T.C.C.	66	62-76
Houdriflow	68	65-78
Propylene, per cent of propane-propylene:		
Fluid	71	60-76
T.C.C.	62	54-65

Higher reaction temperature produce a larger proportion of olefins.

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Cross-Section and Two-Cone Bit Designs

by H. G. Bentson
H. C. Smith Oil Tool Co.

IN the discussion this far, the application of design factors to specific bit types has been limited to the three-cone rock bit. As previously discussed, most of these design factors are applied in a similar manner to the cutting structure of cross-section and two-cone designs.

However, since the geometry of these designs varies from that of the three-cone bit, a limited discussion of the design factors in relation to specific cross-section and two-cone bit types is desirable.

Fig. 25 illustrates a typical A type of cross-section bit designed for drilling soft formations having low compressive strength and high drillability. As stated previously, this formation type of bit is drilled best with maximum gouging - scraping action developed by nontrue rolling characteristics of the moving segments.

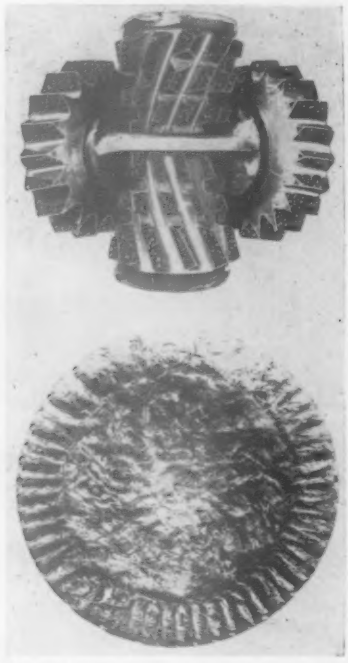
Cross-section . . . In a cross-section bit, this effect is governed by a combination of the journal-angle degree and the geometry of the cutters. For the A type of bit, a reduced journal angle in combination with cutters whose geometry more nearly approaches that of a cylinder is used to develop rolling characteristics.

Maximum tooth penetration is obtained by the deep slender teeth which are widely spaced to provide optimum self-cleaning properties. Deletions may or may not be used depending upon the make of the bit.

Gage protection is provided by the application of tungsten carbide facing to the outer ends of the gage teeth. As illustrated in the photograph, facing is usually applied over one full face and the tip of the opposing face of all teeth for increased wear resistance. However, in some instances, full facing is applied to both sides of the teeth for added wear resistance in abrasive formations.

Additional facing is applied to the outer ends of the crosscutter teeth to prevent premature wear of the outer tooth crests.

TYPICAL TYPE A of cross-section bit and bottom-hole pattern. Fig. 25.



TYPICAL TYPE C of cross-section bit and bottom-hole pattern. Fig. 26.

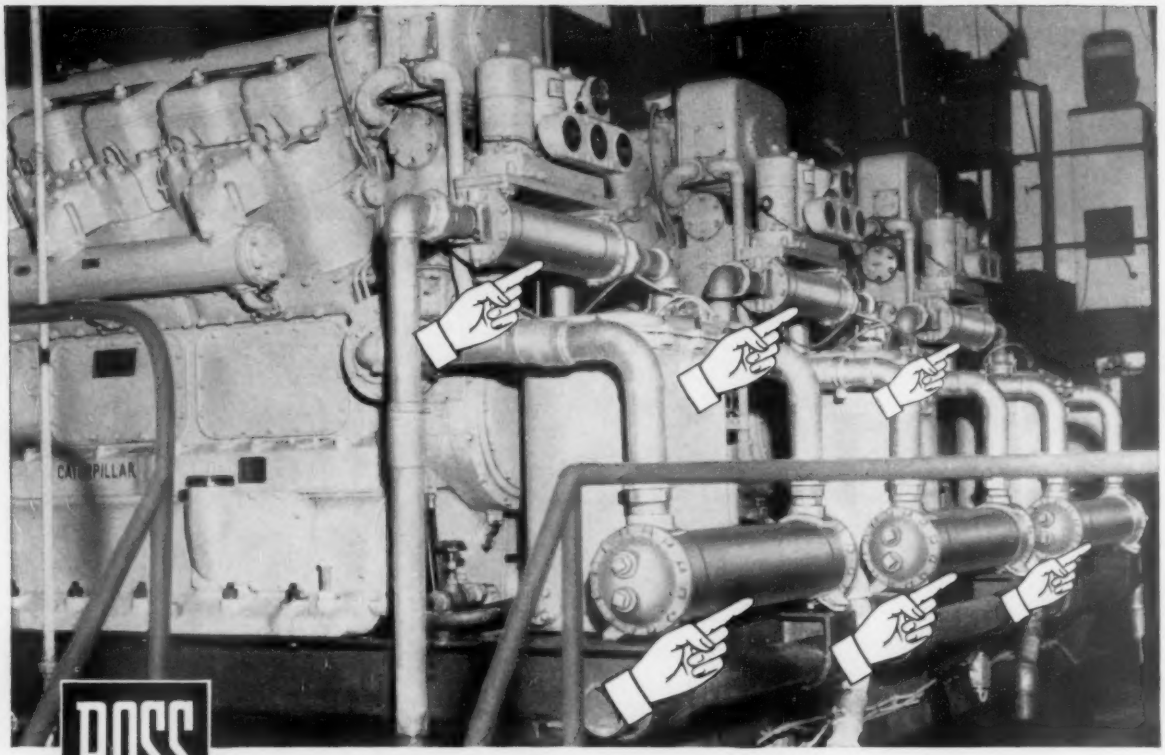
Bearing capacity . . . Since tooth depth is maximum in this design, bearing capacity must be minimum. Evidence of the gouging-scraping action is illustrated by the photograph of the bottom-hole pattern. The gouging action by the gage cutters and the outer teeth of the crosscutters is identified by the rougher surfaces; whereas, the scraping action by the inner teeth of the crosscutters is apparent from the smooth appearance toward the center of the pattern.

A typical C type of cross-section bit for use in soft to medium formations interspersed with hard streaks is illustrated in Fig. 26. An efficient gouging-scraping action is maintained in this design for rapid penetration of the softer formations.

In comparison to the A type of cross-section bit, however, the geometry of the cutters deviates more from that of a cylinder to provide the greater chipping action required to drill the harder formation streaks. The teeth are more closely spaced, slightly heavier and shallower than those on the A type of bit, and consequently provide additional gage protection.

Tooth facing is again applied over one full face and the top of the opposing face of each tooth, and to the outer ends of the crosscutter teeth. Due to the heavier bit loads used on this bit, the space gained by the reduction in tooth depth is used to increase the bearing capacity.

The effect of increased chipping action and greater number of teeth is evident from a comparison of the bottom-hole pattern generated by this design and that by the A type of bit.



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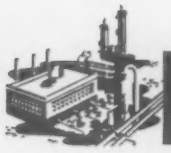

JOB IMPROVEMENT FOR THE PROCESS FOREMAN—76

How Conductivities of Materials Compare

THE coefficients of thermal conductivity of various common materials are shown in Table 6. Liquids and gases are much poorer conductors than metals. Iron conducts 100 times as well as water and water conducts 25 times as well as air.

Radiation . . . If an iron ball is heated and hung up in the room, the heat can be felt when the hand is held under the ball. This cannot be due to convection because hot air currents rise. It cannot be due to conduction because gases are poor conductors.

Similarly, lighted electric light bulb feels hot if the hand is held near it, but when the light is turned off, the sensation stops very quickly. The glass of the bulb is a poor conductor and there is very little air in the bulb; therefore, the sensation of heat can be due neither to convection nor conduction.

Also, if a book or screen is placed between the heat source and the hand, the sensation immediately ceases. These effects are caused by the travel of heat waves in straight lines through the atmosphere similar to light. Experiments can be performed to demonstrate that, like light waves, heat waves can be reflected by a mirror, or brought to a focus by a magnifying glass.

Oil tanks . . . The knowledge and understanding of radiant heat has made it possible for industry and the military to develop methods and instruments to more accurately perform their work with ease. Oil-storage tanks are painted suitable colors to either promote or reduce heat absorption by radiation from the sun.

At one time, sensitive instruments were used by the military to locate aircraft by detecting and establishing the direction of the heat radiated by their engines.

This material is taken from "Fundamentals of Refining," operating manual of Magnolia Petroleum Co., refining division, Beaumont, Tex.

Review . . . It has been established that there are three methods by which heat can be transmitted:

1. Convection—transporting heat by carrying hot portions of a fluid from one place to another.

(a) Typical example: Home water heater.

2. Conduction — the passage of heat from one part of a substance to another part of the same substance or from one substance to another in physical contact with it, without the movement of particles of either substance.

(a) Typical example: Metal spoon in hot coffee.

3. Radiation—the transfer of heat through space by waves that travel in straight lines.

(a) Typical example: Heat from an electric light bulb.

With the basic principles of heat transfer established by definitions, consider those factors that effect the transfer of heat energy from one substance to another.

Temperature . . . The first consideration is temperature. In order to transfer any energy or matter from one substance or location to another, there must be a driving force. In pumping water or oil through a pipeline, the driving force is pressure and the amount of liquid moved is proportional to the pressure difference.

Similarly, the transfer of heat is proportional to its driving force—temperature difference. Heat is always transmitted from a warmer body to a colder one and the greater the difference in temperature of the two bodies, the greater the amount of heat exchanged.

It would be well, at this point, to define the unit of measure used in this country and the English-speaking world for measured heat quantities. This yardstock is the B.t.u. The letters, B.t.u. are abbreviations for British thermal unit. The B.t.u. is defined as the heat energy required to raise 1 lb. of water 1° F.

Now to consider the second factor influencing heat transfer. Opposing the movement of all matter and energy is a force called resistance. Pipe roughness, valves, fittings, etc., offer this resistance to liquids flowing through pipes.

The transfer of heat is opposed by a factor called thermal resistance. This opposition is caused by the material of the container (exchanger tube), stagnant fluid films and scale or trash on the tube wall.

TABLE 6—TABLE OF THERMAL CONDUCTIVITIES

Material—	Temp. (°F.)	Thermal conductivity, K*
Building materials:		
Asbestos	212	0.111
Asphalt	68	0.43
Building brick	68	0.4
Brick, insulating	392	0.05
Coke	212	3.4
Cork	86	0.025
Wood, pine	59	0.087
Metals:		
Aluminum	212	119
Brass	212	60
Copper	212	218
Cast iron	212	30
Steel	212	26
Liquids:		
Gasoline	86	0.078
Kerosine	68	0.086
Toluene	68	0.086
Water	86	0.356
Gases:		
Air	212	0.0183
Ammonia	212	0.0185
Butane	212	0.0185
Carbon dioxide	212	0.0133

*B.t.u./hr.-ft.²-°F./ft.

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PART 1 OF A NEW SERIES

REFINER'S NOTEBOOK

CORROSION OF FERROUS-METAL TUBING

Corrosion Is a Complex Problem for Refineries

by Thomas M. Krebs

THE importance of corrosion as an industrial expense resulting from deterioration of capital equipment, increased maintenance, and lost production time is universally recognized.

Apart from accounting practice, this fact is manifest from the volume of technical literature dealing with the subject, the industrial emphasis on corrosion preventives and corrosion resisting materials, and particularly from the experiences of operating and maintenance personnel and others who deal with this problem.

As compared with the over-all industrial picture, corrosion in the oil refineries of petrochemical plants may be more varied and more severe. This follows from the complexities of these facilities. Their processes require materials to serve in an amazing number of conditions involving a myriad of corrosive media, both organic and inorganic, over a wide range of operating temperatures.

Refinery service . . . In view of the varied nature of materials application in refineries and the attendant corrosion problems, an attempt was made to restrict the subject matter of this article. Only the corrosion of ferrous tubing materials in refinery service is presented.

This is a broad subject but the nonferrous metals, i.e., copper, aluminum, etc., are included together with the corrosion problems peculiar to these materials.

Ferrous tubing refers to the iron-base tubing alloys, ranging from common carbon steel through the alloys such as the chrome-moly series and also includes the high-alloy stainless steels. These are basic materials of construction in the modern refinery or related chemical plant. Confining the subject to tubing does not prevent a discussion of corrosion since the principles of corrosion apply regardless of metal shape. Actually, service conditions for tubing are often especially rigorous because of the presence of potent corrosives at both surfaces, as in heat-exchange applications.

Consequently this restriction of form results only from circumstances of predominant experience and familiarity with applications in the tubing field. For 30 years we have supplied tubing from the entire family of ferrous materials ranging in size from small heat-exchanger tubing to large still tubes for specialty application in corrosive service in refineries.

The author is metallurgist, Tubular Products Division, Babcock & Wilcox Co. Article presented at Western Petroleum Refiner's Association meeting, Wichita.

Common denominator . . . Since corrosion is variously interpreted, it would be well to establish a common denominator at the outset. We will define corrosion as any deterioration of a metal or its properties involving chemical action.

This is far reaching but proper for the practical refinery man to whom the term must convey more than to the layman. The layman invariably visualizes corrosion as the rusting of a water pipe or the pitting of an auto's stainless trim, and little more. Thus for the refiner a piece of metal may be said to be corroded when it has lost its metallic integrity, strength, properties—i.e., its usefulness and worth—through chemical action.

Obviously, such a general topic cannot be covered in minute detail in a presentation of this type. Therefore, the object will be to outline some of the general features of ferrous-metal corrosion omitting the more theoretical aspects in favor of a simple discussion of types of corrosion together with illustrations.

Corrosion is not simple to classify because of the variety of the mechanisms and forms of corrosion and the interrelation and overlapping among them. For the refinery observer the appearance of the affected metal and knowledge of process conditions will usually permit the corrosion to be typed as one of the following forms. These forms will serve as a rough guide but they are recognized as not necessarily mutually exclusive classes.

1. General chemical attack in which an over-all deterioration of metal occurs with or without the formation of visible corrosion products.
2. Local attack in which the action tends to localize to the exclusion or lessening of corrosion of adjacent portions of the metal, e.g., pitting.
3. Mechanical-chemical corrosion involving the combined action of mechanical and chemical effects, such as erosion-corrosion or stress corrosion cracking.

Types of attack . . . The most obvious case of general chemical attack is the attack of acid on a metal with the formation of hydrogen and a salt of that metal. At low temperatures this type of attack may be expected in acid storage, handling, or process equipment. But a frequent case in refineries and industrial service is the corrosion of tubing or other equipment from water solutions in which the dilute acid constituent may be present as a contaminant or byproduct of some reaction.

THIS 200-MILE 10-INCH CRUDE LINE between Bismarck and Fargo, North Dakota was right on schedule with trenching done by a Cleveland 140 for Associated Contractors of Houston, Texas.

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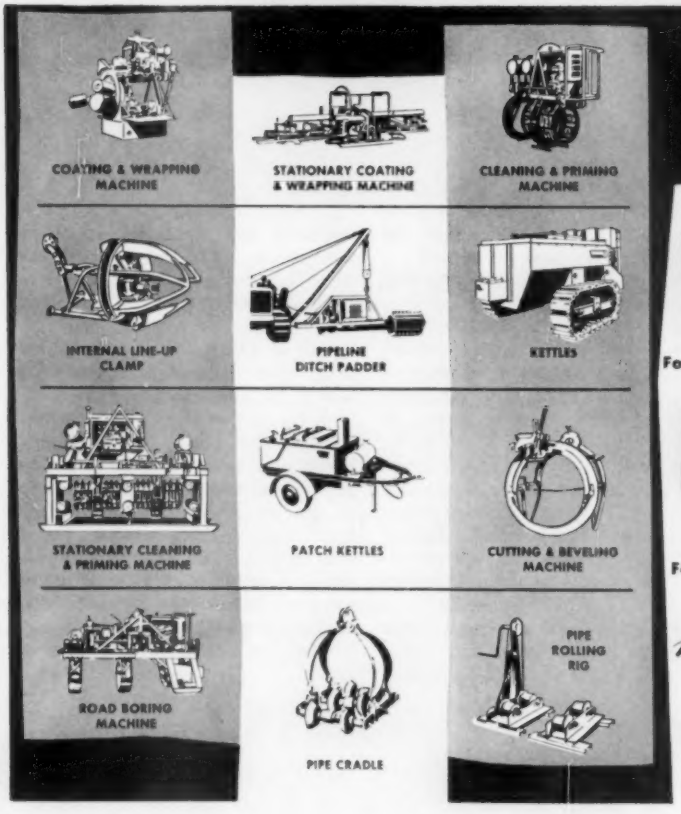

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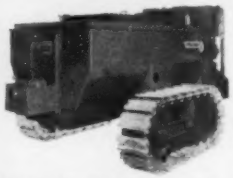

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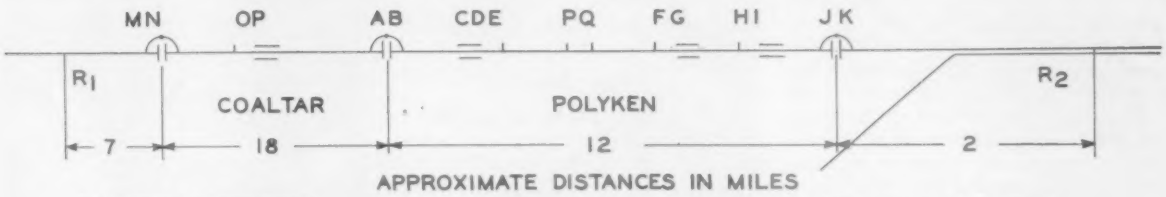

CATHODIC-PROTECTION system installed on the complete line. Two rectifiers, R_1 and R_2 are shown here. Fig. 1.

Two adjacent sections tested and . . .

Polyethylene tape proves value

by Marshall E. Parker
Consulting Corrosion Engineer
Houston, Tex.

LATEST results of a projected long-term test of the value of polyethylene tape pipe wrap as compared to conventional coating materials indicate a superiority of the tape in a ratio of 3:1, when compared on the basis of current required for cathodic protection.

The comparison is being made on two adjacent sections of the Seadrift Pipeline, located in Refugio and Goliad counties, Texas, on the Gulf Coastal Plain. The line is of 8-in. welded steel, and both sections lie in soil which is very uniform in composition, texture, and resistivity.

Test sections . . . The tape section is 12 miles in length; the protective system consists of a single wrap of polyethylene tape (Polyken 900), consisting of an oriented polyethylene film 8 mils thick with an adhesive mass of 4 mils. The tape was applied directly to the machine-cleaned pipe, with an overlap of ½ in., and was covered with an unbonded outer wrap of coaltar-saturated asbestos felt.

The coaltar section, immediately adjacent, is 18 miles in length. The enamel was applied to a minimum thickness of 3/32 in. to the cleaned and primed pipe, and was covered with a bonded wrap of glass-reinforced tar-saturated felt (Vitron). The two test sections are isolated from each other and from the remainder of the system by insulated flanged joints; bonds are installed across these joints for cathodic-protection purposes, so arranged that they may be opened for testing. Both sections were laid in February 1954.

Cathodic protection . . . In September 1955 a cathodic-protection system was installed on the complete pipeline of which the two test sections are a part. A number of rectifiers are used, two of which, designated as R_1 and R_2, are shown in Fig. 1.

In March 1956 the response of the two sections to the cathodic protection was tested as follows:

First, the bond J—K was opened, and several hours allowed to pass to permit stabilization of potentials. It was found that the Polyken section B—J was adequately protected by the current from R_1 alone. The pipe-to-soil potential (referred to a standard copper-copper sulfate electrode) ranged from a maximum of 966 mv. to a minimum of 888, the mean being 936. A total current of 74 ma. was being drained from the section to produce this potential, thus indicating a demand of 6.16 ma. per mile.

The bond A—B was then opened, and, after stabilization, the coaltar section was found to have a maximum potential of 1,263 mv. and a minimum of 1,042, with an average of 1,158. This was produced by a current of 564 ma., or 31.33 ma. per mile.

Comparison . . . In order to make a fair comparison, the two sections should be reduced to the same average potential. To produce a mean pipe-to-soil potential of 1,000 mv. would require 88 and 405 ma. respectively for the two sections, or 7.33 ma. per mile for the Polyken and 22.50 ma. per mile for the coaltar. This is the 3:1 ratio referred to—the ratio in current required to produce the same potential on equal sections with the two coatings being compared.

Corrosion engineers are almost unanimously agreed that the most economical corrosion control program for a buried pipe is a proper combination of coating and cathodic protection. When two coatings are comparable in total applied cost, the one with the lower current requirements is clearly the material of choice.

The polyethylene tape used on this project was applied by a manually operated machine, originally designed for the wrapping of short sections of line. There are now available for all sizes of pipe up to 36-in., power-driven machines for the simultaneous application of the tape and the outer wrap, capable of speeds which will easily keep up with the other operations incident to laying a pipeline *(The Oil and Gas Journal, November 26, page 70)*.

The use of this equipment makes the presently attainable total applied cost of the polyethylene tape with outer wrap comparable to that of conventional systems.

Service life . . . The remaining question—one to which no absolute answer can be given at present—is that of the ultimate service life of the tape. The line in question is over 2 years old; the oldest buried piping with polyethylene tape is but 7 or 8 years old; the material itself is little older.

These early lines are mostly short sections, not isolated from other structures, and have not been made the subjects of specific tests; it can only be said of them that the coating has not failed.

All other inferences as to the life of polyethylene must be based on its known extreme inertness and stability in a wide variety of environmental conditions. These properties make it highly unlikely that it will suffer any chemical

attack or disintegration underground.

It is, of course, subject to mechanical damage, and will undoubtedly suffer some punctures and breaks from contacts and pipe movement. Since the material is tough and elastic, it is difficult to imagine any extensive propagation of these breaks; they will simply constitute a number of small exposed areas of bare pipe, which will only constitute a slight additional load on the cathodic protection system.

A total bare area, from such causes, of an additional square foot per mile (which would require hundreds of small punctures) would only increase the current demand for cathodic protection by 2 of 3 ma.

Conclusion

Here, then, is a valuable weapon for the fight against corrosion—a coating system which is comparable in total applied cost to the better grades of conventional coatings. It can be applied under a wide range of working conditions. It has current requirements so low that there are important savings in the direct cost of cathodic protection, plus the advantages of greater freedom in the design of systems, and relative freedom from interference problems.

THIS 36-IN. COUPON shown inside the giant cutter is the largest ever cut from a pipeline with a high-pressure, high-temperature tapping machine. Shown alongside the WmSON-HILLCO tapping machine and coupon is Hershel Vanzant, research engineer for T. D. Williamson, Inc., Tulsa.

Plastic-film data compiled

. . . N.A.C.E. mails questionnaire

A QUESTIONNAIRE on prefabricated plastic films for pipeline coating has been prepared by the History and Results Tank Group of Unit Committee T-2K of the National Association of Corrosion Engineers.

At San Antonio and Philadelphia, meetings of Unit T-2K were held during the Northeast and South Central Regional conferences. Performance data on plastic films are still being compiled by the committee. Recommended specifications will be prepared for prefabricated plastic film that can go into the T-2 Minimum Requirements for Pipeline Protection Report.

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Atomic radiation detects pipeline-product changes

ATOMIC radiation is now being used by Atlantic Refining Co. for quick detection of batch changes and quality variations of petroleum products flowing through its pipeline.

Atlantic Refining's subsidiary, Atlantic Pipe Line Co., has installed a density gammagage on its 8-in. products line at Caledonia, N. Y. The instrument continuously records the density of the material passing between a gamma-ray source on one side of the pipe and a radiation detector on the opposite side. This device, the company believes, may lead to automatic timing of product changes and control of undesirable quality variations.

The gamma-ray source is a powerful cobalt 60 unit, capsuled in aluminum to prevent contamination. The source is shielded in a 150-lb. lead block (shown right in Fig. 1), insuring perfect safety of operating personnel from radiation. The block is fitted with a positive shut-off mechanism for safe maintenance.

Opposite to the source on the other side of the pipeline the detector chamber (left) is mounted. This unit is a highly sensitive and stable-pressure iron chamber, filled with 200 lb. per square inch of the inert gas argon. The control cabinet contains the balancing circuit, amplifier, and power supply.

Changes in the A.P.I. gravity of

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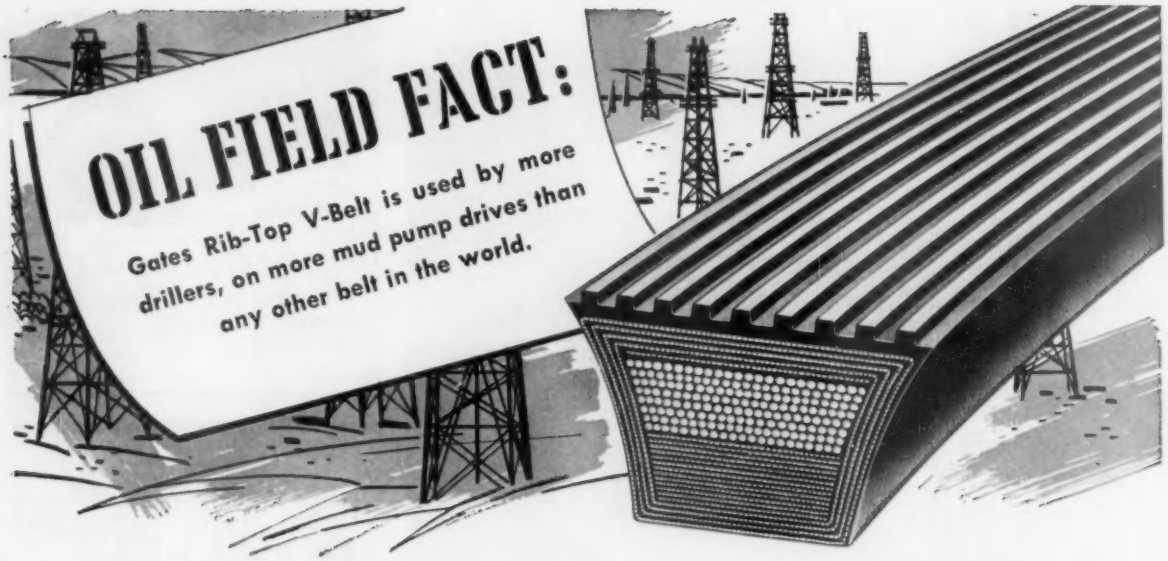

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Among the Drilling Contractors

Calvert Drilling Expands Midwestern Operations

A. J. Magness, part owner of Calvert Drilling, Inc., recently moved his office to Oklahoma City from Olney, Ill. Magness is in full charge of field operation and producing properties. Expanded operations in the Mid-Continent, Rocky Mountains, and West Texas have dictated this move.

A. J. MAGNESS

Magness has seen Calvert Drilling grow from one rig when he first started with the company in 1946, to 13 today. Within the last 6 months, the company has moved into the West Texas area, switching 2 rigs from the Rocky Mountains. Calvert now has 3 rigs in Oklahoma, 3 in North Dakota, 5 in Illinois, and 2 in West Texas.

In 1955, the company drilled 200 wells and 1 million feet of hole. This is an average of 15 wells per rig during the year. Total footage drilled in 1956 again will exceed 1,000,000 ft.

Grey Wolfe Drilling Co., Houston, has contracted for another deep test J. M. Flaitz and R. B. Mitchell will drill off the northeast flank of Napoleonville dome, in Assumption Parish, southeastern Louisiana. It will be at 1 Savoie Estate, in 30-12s-13e. Planned depth objective is 13,500 ft. The contractor's rig currently is on the same operators' 1 Klotz, with hole near contract depth.

Falcon Seaboard Drilling Co., Tulsa and Houston, is drilling a deep test for Champlin Oil & Gas Co. in the new extension development around the north and northwest flanks of Gueydan dome on the Vermilion - Acadia parish line, southwestern Louisiana. Champlin's job, planned to go to 11,500 ft., is 1 Simon and others, in 37-11s-1w, on the Acadia Parish side.

Payne Drilling Co., Corpus Christi, Tex., is drilling on another wildcat test Delhi-Taylor Oil Corp. is undertaking northwest of Sinton, in San Patricio County, South Texas. Location is at 1 Hughes, in the George Morris Survey, about 5 miles northwest of town. Drilling is set up to go to 8,100 ft. It is about a mile northwest of another test this contractor has just completed for the same operator at 1 Hayes, in the same survey. The latter, drilled to 8,015 ft., has been testing a 6,545-ft. sand.

Camay Subsidiary Company Drops Mesa Designation

Mesa Drilling Co., wholly owned Rocky Mountain subsidiary of Camay Drilling Co., Compton, Calif., is dropping its name and separate identity to operate as a division of the parent company. Effective January 1, its designation was changed to Camay Drilling Co., Rocky Mountain Division.

There is no change of management or personnel. The division will retain its present address in the Denver Club Building, at Denver, with M. D. McBride as division manager, and F. B. (Buster) Link, division drilling superintendent.

Circle Drilling Co., Lake Charles, La., is drilling on a new contract job east of Welsh, in Jefferson Davis Parish, southern Louisiana. It is for David C. Bintliff and associates at 1 Maebers, in 31-9s-4w. Location is about 2 miles southeast of production on Welsh dome. Permitted depth is 11,000 ft.

Penrod Drilling Co., Shreveport, has scheduled an ultra - deep test in the Pointe Au Fer area, at the southwestern coastal tip of Terrebonne Parish, Louisiana. It will be drilled as a contract operation for Hassie Hunt Trust at 1 Mary Smythe Nelson-State Lease 2785. Projected depth is 16,500 ft.

H.E.T. Drilling Co. has the contract on a deep test Lloyd H. Smith, Inc., of Houston, is putting down northwest of production in the Ellis area, 8 miles northwest of Crowley, in Acadia Parish, southern Louisiana. Drilling is set up to go to 11,500 ft., sufficient to look at the third Nodosaria series. Location is at 1 Killmer, in 10-9s-1w.

Deckard Drilling Co., Shreveport, is on a new 9,000-ft. job it has contracted for Jett Drilling Co., Inc., Dave Gammill, and Hilton Ladner. It is a wildcat test about a mile southeast of Maxie field, in Forrest County, southern Mis-

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Flournoy Drilling Co., Alice, Tex., is Sunray Mid-Continent Oil Co.'s contractor on a new 4,000-ft. wildcat operation in the Jaboncillos Creek area, 7 miles northwest of Santa Cruz, in Duval County, Southwest Texas. It is the operator's 2 Saenz, in the La Huerta grant.

Brewster-Bartle Drilling Co., Houston, has contracted for a 13,500-ft. test Magnolia Petroleum Co. has projected for the southwest flank of Lake Arthur field, in Jefferson Davis Parish, Coastal Louisiana. It is at 1 Hawthorne, in 2-11s-4w.

Circle Drilling Co., Lake Charles, La., is starting another well for the North Elton area, in Allen Parish, southern Louisiana. It is a contract job for Bel Oil Corp., also of Lake Charles, at 1-A Goodrich Unit, in 32-6s-3w. Contract is for 8,700 ft.

Glasscock-Wilson, Inc., Shreveport, will drill a 9,500-ft. test about 2 miles west of Bayou Mallet field, in northern Acadia Parish, southern Louisiana. It is a contract job for Argo Oil Corp., A. C. Duerr, and R. N. Hart at 1 Bazine, in 43-7s-1e. Location is about 3 miles southeast of Eunice.

Leecraft Drilling Co. is under way on a 4,000-ft. wildcat test it has contracted to drill for Paul J. Moore in the general Stuart City area, 7 miles south of Artesia Wells, in southwestern LaSalle County, Southwest Texas. The test is Moore's 1 Martin. Spot is in the J. M. Martin Survey 696.

Owen Drilling Co. has another contract operation at Bayou Blue, in Iberville Parish, southern Louisiana. It is for Bradco Oil & Gas Co. and Meredith & Co. at 1 Kurzweg, in 72-9s-11e. Projected depth is about 5,500 ft.

Gulf Drilling & Well Service, Inc., is getting under way on an 11,500-ft. contract it has with Sohio Petroleum Corp. for a wildcat test 2 miles south of South Welsh field in Jefferson Davis Parish, southern Louisiana. Location, at 1 Todd, in 18-10s-4w, also is about 2 miles northwest of South Roanoke field.

Fleet Drilling Co., Ada, Okla., is drilling for Reynolds Mining Corp., of Fort Smith, Ark., at an outpost location in the Gragg area, Sebastian County, West Central Arkansas. Plans call for a 5,000-ft. test. Location is on the operator's Nichols lease, in 25-6n-30w.

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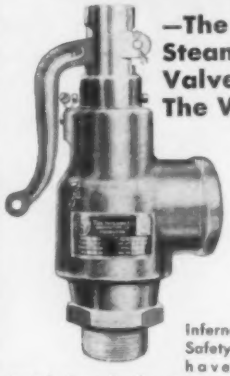

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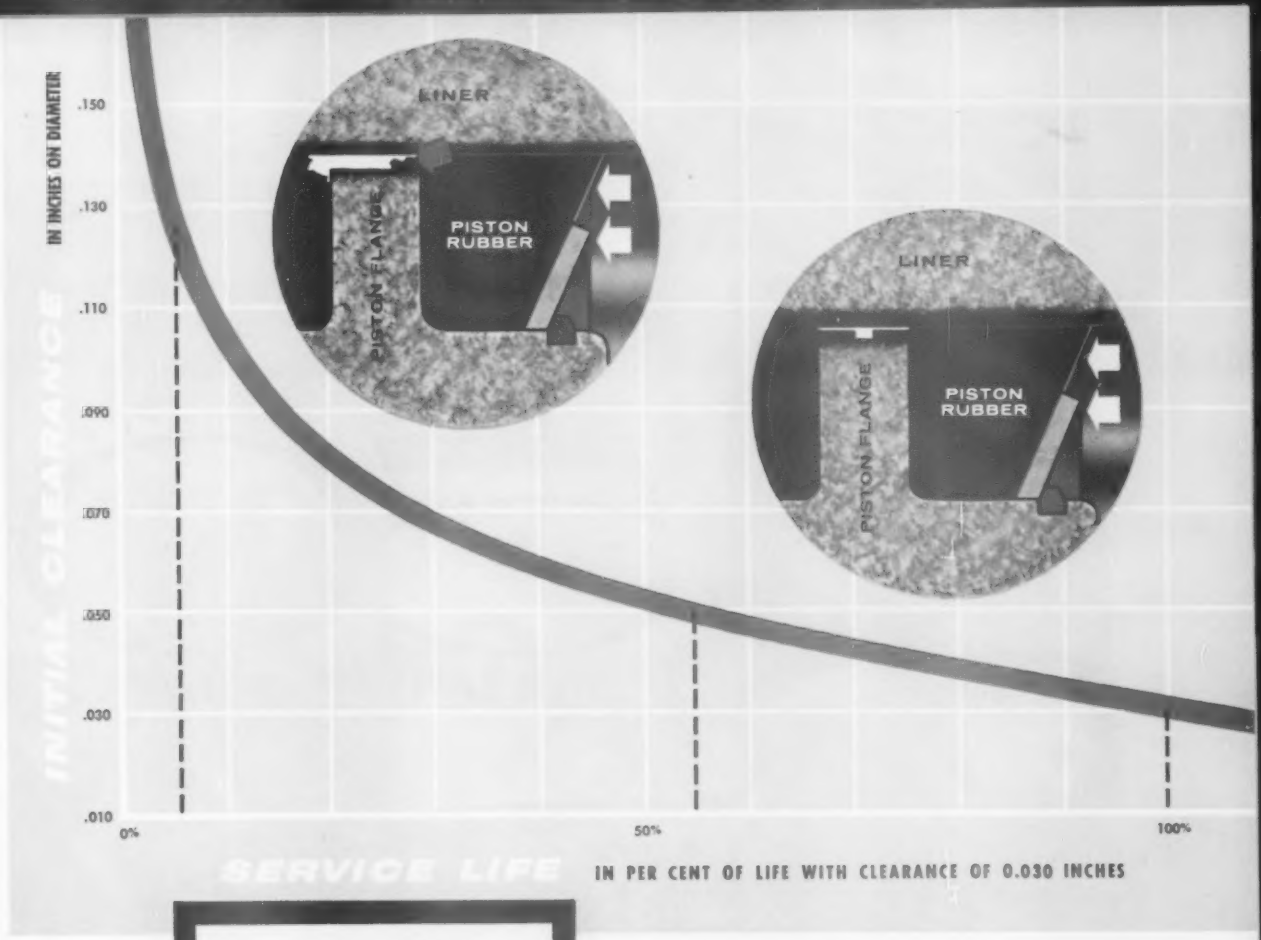

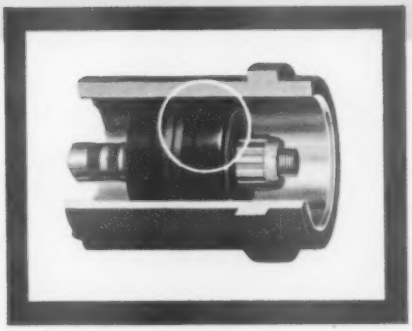

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There is one important thing the chart does not show, however. You get closer clearances—*longer*—when you use *both* Mission Pistons and Mission Liners. Precision machining, together with advanced metallurgy and heat treating, accounts for this longer life.

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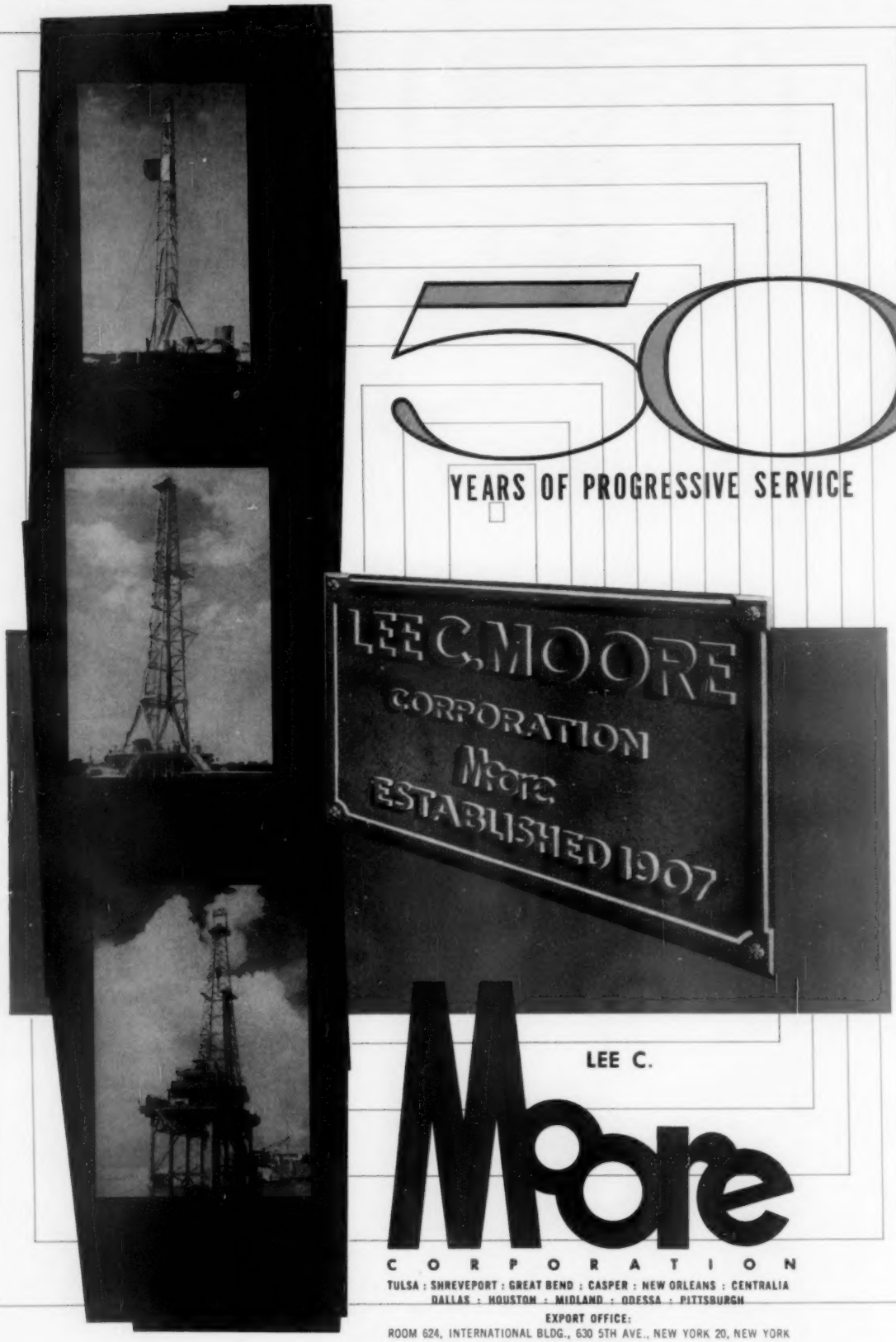

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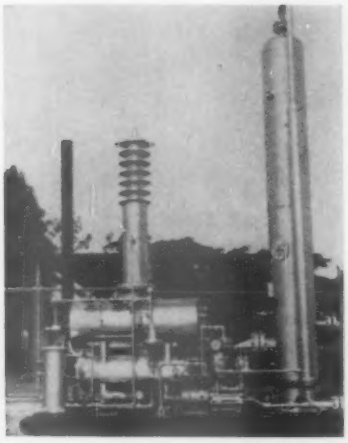
Showcase

OF NEW EQUIPMENT AND LITERATURE

by Dan B. Miller



Gas Dehydrators are Skid Mounted, Use Glycol

A new line of glycol-gas dehydrators offers processing capacities ranging from 1,700,000 to more than 60,000,000 s.c.f.d. The new line includes 42 dehydrators. They reduce water-vapor content of natural gas to less than 7 lb. per million standard cubic feet of gas or depress the water-vapor dew point of the gas to 65° F., whichever is reached first. These performance standards are based on inlet gas temperatures of 100° F. or lower. The water-absorbing capacity of the units is increased through action of an external glycol-gas heat exchanger which cools the glycol before contacting the gas stream.

The dehydrators are automatic. They are equipped with absorber liquid-level controllers, dual reboiler temperature controls, and glycol circulation-rate control valves.

Prefabricated piping and factory-applied insulation reduce field hookup time for the skid-mounted glycol reconcentration units. Both the unit's absorber and inlet scrubber may be skid-mounted. Weights of the new glycol dehydrators range from 1,800 to 48,500 lb. **Write or call: Delta Tank Mfg. Co., Baton Rouge, La., for more information on glycol gas dehydrators.**

New Mud Pump Delivers 884 G.P.M.

A new 1,250-hp. mud pump, the GH-GXH, has an 18-in. stroke for heavy duty drilling service. The master-size liner is 7¾ in., which may be reduced through five liner sizes to 6 in. The GXH delivers from 884 g.p.m. at 2,060 psi., using master 7¾-in. liners, to 500 g.p.m. at 3,642 psi. with

Send this *Showcase Coupon*

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in boldface type at end of description.

• • •

NAME AND/OR MODEL NUMBER _____

_____

_____

Described in The OIL AND GAS JOURNAL - Issue of Jan. 14, 1957

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

DATE _____

His job is to protect Parkersburg's reputation

Parkersburg is the first name in the design and manufacture of gas handling and treating vessels. In its Houston plant, 196 different types of vessels are made . . .

. . . and each undergoes rigid checks by ASME inspectors for quality of material and performance.

Parkersburg, where quality and service have gone hand-in-hand for 60 years, is proud of its reputation as the leader in the design and manufacture of gas handling and treating vessels. This position was gained by providing the best engineered and safest equipment in the field, a reputation Parkersburg will go to any end to protect.

Each pressure vessel made by Parkersburg is subjected to inspections that are even more rigid than those required by the code under which it is manufactured. Not only is each vessel checked upon completion for performance in excess of its rated capacities, it is also inspected during fabrication for the quality of materials used. To pass these inspections, made by examiners licensed by the American Society of Mechanical Engineers, each vessel must meet rigid specifications.

That's why if you are looking for quality and performance, you can look to Parkersburg for gas handling and treating vessels. We stake our reputation on our products.

The Parkersburg plant at Houston

ASME Inspectors at Parkersburg

AT PARKERSBURG, QUALITY AND SERVICE
HAVE GONE HAND-IN-HAND FOR 60 YEARS

Parkersburg
RIG AND REEL COMPANY
DIVISION OF PARKERSBURG • AETNA CORPORATION

3345 WINTHROP AVENUE
FORT WORTH 16, TEXAS

PESA

6-in. liner. Hydrostatic tests at 9,000 psi. on discharge and at 4,500 psi. on suction prove ample working-pressure ratings of 4,500 psi. on discharge and 2,250 psi. on suction. A counterbalanced eccentric reduces unbalanced forces which are normally transmitted to the pump foundation or platform. Threaded fluid cylinder locks and rings are interchangeable with those used on the valve pots. A surge chamber is available as an accessory. It is furnished complete with a boom and a ½-ton hoist with trolley and air hose for easy handling of fluid-end parts. Shipping weight with steel skids is about 74,500 lb. **Write or call: Gardner-Denver Co., Quincy, Ill., for more information on the GH-GXH mud pump.**

●

Motor Power Varies As Air Temperature Varies

A new line of totally enclosed air-over a.c. motors produces varying horsepower according to varying air velocities. The cooling effect of the air flow over the motor frame created by the fan or blower it powers creates this effect. Power output can be increased without exceeding the rated temperature rise of the motor. Features of the new line include cast-iron ribbed-frame construction, oversized double-shielded ball bearings, and metermatic lubrication with automatic grease relief. Heavy formvar nylon-coated magnet wire is used for coils. Six coats of insulating varnish have been applied to the wire.

Connection is simplified by the leads being numbered and indexed through a neoprene gasket between the frame and conduit box. The indexing corresponds to the connection diagram on the nameplate. The motors are available in the new N.E.M.A. frame sizes from ½ through 30 hp. and may be operated on 208-volt network systems.

Normally supplied in nonventilated construction, explosionproof Class 1, Group D and Class 2, Groups E, F, and G enclosures are available also. Other options include the choice of foot or footless mounting, N.E.M.A. C-face or D-flange brackets, and a mounting plate for a long connection cable instead of a conduit box. **Write or call: Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio, for more information on totally enclosed, air-over a.c. motors.**

●

Pulsation Dampener Handles 2,500 and 5,000 Psi.

The new Model MPB series pulsation dampener uses a long-lived, heavy-duty cartridge. It permits inflation to withstand greater pressures while giving 33⅓ per cent more displacement than the MP series pulsation dampener now in service in oil fields. The Model MPB is available with working pressures of 2,500 and 5,000 psi. with a safety factor of 2. Up to three of these units can be installed directly in the line to meet the requirements of the larger reciprocating pumps. This mounting method is important where headroom is limited. **Write or call: Gadco Products, Inc., 1500 East Burnett, Long Beach, Calif., for more information on the Model MPB series pulsation dampener.**

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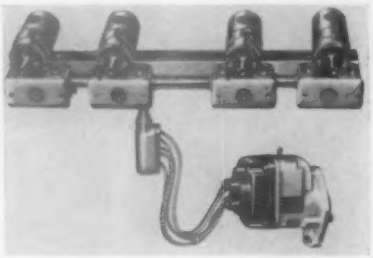

New Low-Tension System Boosts Ignition Efficiency

A new line of low-tension ignition systems can be used for most large spark-ignited engines with two, three, four, six, and eight cylinders. This

Send this *Showcase Coupon*
to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in boldface type at end of description.

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NAME AND/OR MODEL NUMBER _____

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Described in OIL AND GAS JOURNAL - Issue of **Jan. 14, 1957**

NAME _____ TITLE _____

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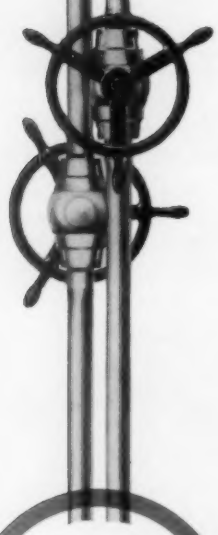
. . . a practical low cost and efficient way to control a dual completed well!

ORBIT forged steel SCREW END VALVES



ORBIT VALVES®

The compact design and full round opening feature of Orbit Forged Steel Production Valves makes the Screw End type readily adaptable to dual string surface control. By using ORBIT SCREW END VALVES with the recessed body to permit perfect tubing alignment, a tremendous savings can be realized over other types of valving for dual completions. Orbit Forged Steel Valves are built for continuous heavy duty production service, they always operate easy and shut off when called upon to do so. Plastic with Teflon base is used as a stem packing, it is adjustable, pliable, and new packing may be added if necessary while the valve is in service and under pressure.

Orbit Dual String Tubing Valves are available through your favorite Well Head manufacturer in both carbon and stainless steel trim, sizes: 1½" and 2" 4000 lbs. test, 2000 lbs. WP; 2" 6000 lbs. test, 3000 lbs. WP; 2" 10,000 lbs. test, 5000 lbs. WP; and 2½" 6000 lbs. test, 3000 lbs. WP, screw ends only.

Write for bulletin D-1 . . .

ORBIT VALVE COMPANY
Box 699, LUther 5-1277, TWX TU 925
TULSA, OKLAHOMA

WAREHOUSES: Houston, Texas, 407 Velasco, CApitol 8-6623, TWX HO 115; **Odessa, Texas,** 402 West County Road, FEderal 7-2263, TWX ODESSA TEX 8041; **Casper, Wyoming,** 247 West First St., Phone 3-5707, TWX CP 394; **Long Beach, California,** 1425 West 15th Street, HEmlock 7-6206; **Edmonton, Alberta, Canada,** 7119-104th Street, Phone 391-283
CANADIAN REPRESENTATIVE: T. R. Pickford & Company, Ltd., Calgary, Alberta, 536 8th Avenue West, Phone 2-7371
EXPORT REPRESENTATIVE: New York 36, N. Y., 500 Fifth Ave., BRyant 9-2236

system consists of a low-tension magneto with individual high-tension ignition transformers mounted at each cylinder. This design improves performance not only on the new-model engines with their high-compression ratios, but also on older engines in the field.

Not only does the low-tension system provide better ignition firing but it lowers costs, also. With only low voltage present, neither ozone nor high-corona discharges present a problem within the magneto case. Bearings and all other parts last longer because green corrosion and lifeless lubricants that are common problems in high-tension setups are not found.

The low-tension system enables large oil-field engines to operate without constant attention. For example, even if one transformer should go dead on an unattended installation, the engine will continue to operate until repairs can be made. **Write or call: Fairbanks, Morse & Co., Magneto Division, Beloit, Wis., for more information on low-tension ignition systems.**

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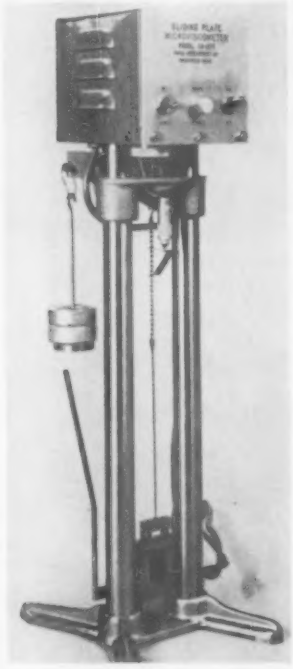


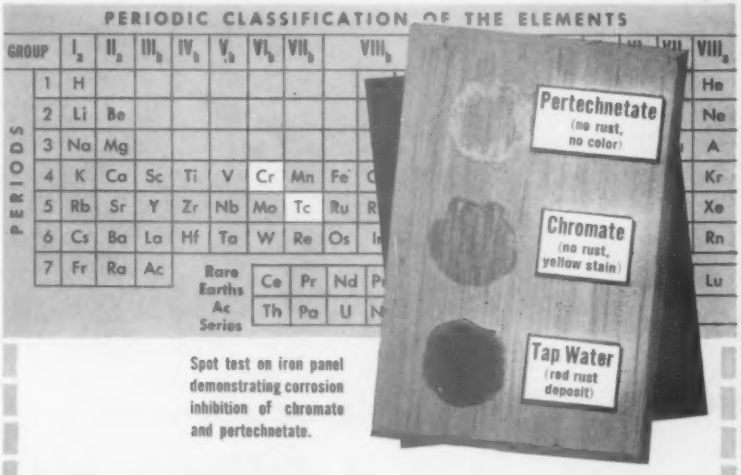
Instrument Tests Asphalt Viscosity and Durability

The sliding-plate microviscometer determines viscosity in absolute units. It tests penetration-grade asphalts, liquid asphalts, and other viscous materials. This viscometer has a range of 100 to 100 billion poises. At freezing temperatures this range permits measuring the viscosity of all products from Grade 1 liquid asphalts to 40/50-penetration paving asphalts. At 77° F. the range is from Grade 3 liquid asphalts to zero-penetration paving asphalts. Since the shear rate may be determined accurately, it is equally applicable to materials having Newtonian or non-Newtonian flow properties.

The microviscometer is designed for operation in constant-temperature water baths normally used for testing asphaltic materials. By using it in baths of different temperature, the viscosity-temperature characteristics of asphalt may be determined directly.

This instrument can be used to measure asphalt durability or life expectancy as well as viscosity. It was designed by Shell Development Co. **Write or call: Hallikainen Instruments, 1341 Seventh**

...what is your
best corrosion inhibitor?



Spot test on iron panel demonstrating corrosion inhibition of chromate and pertechnetate.

Recent research* with a very rare man-made metallic element called technetium has shed new light on the mechanism of corrosion inhibition.

Experiments have demonstrated that even in concentrations as low as 5 ppm and at temperatures of 450° F., pertechnetates completely inhibit iron oxidation. But technetium is a synthetic element obtained by bombarding molybdenum with deuterons, or in the fission of uranium as a fission product. As a result it is extremely scarce and prohibitively expensive.

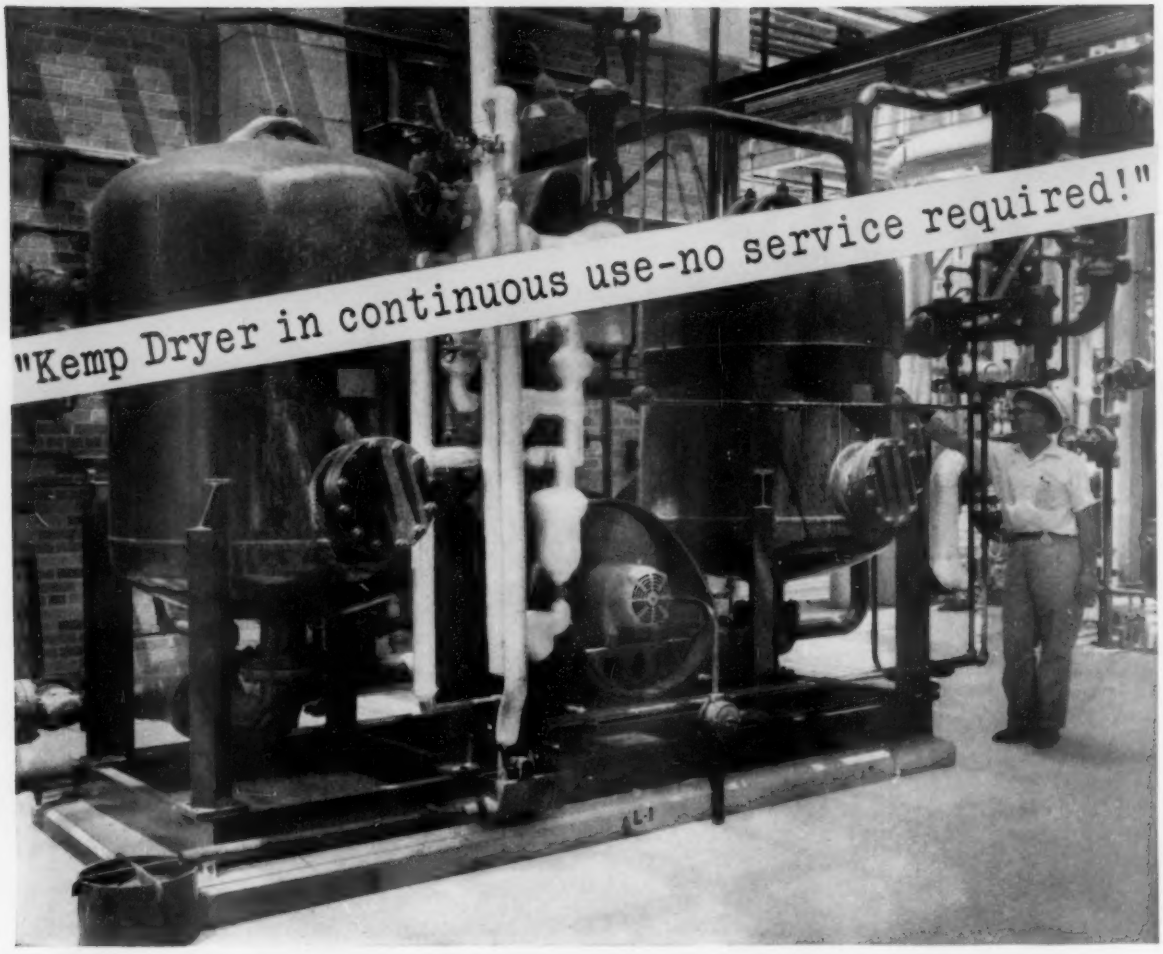
Fortunately, chromates have an ionic structure very similar to that of the pertechnetates, permitting dependable and efficient corrosion control at a tiny fraction of the cost of technetium compounds.

Mutual Chromium Chemicals have been widely used for corrosion control for many years, during which time we have accumulated much useful experience. May we help you with your corrosion control program?

*Sci. Am. 194, 35-39 (May 1956)

Sodium Chromate • Chromic Acid • Sodium Bichromate • Potassium Bichromate • Potassium Chromate

MUTUAL CHEMICAL DIVISION
MUTUAL — ALLIED CHEMICAL & DYE CORPORATION
99 PARK AVENUE • NEW YORK 16, N. Y.



Cities Service Petroleum reports:

Kemp Dryer in continuous operation 7 days a week; has required no service or downtime!

To dry compressed air for instruments in a hydroformer unit at its refinery in Lake Charles, Louisiana, Cities Service Refining Corporation has installed a Kemp Model LC SE2 Air Dryer. Since January, 1955, it has served continuously—seven days a week—drying 1900 cubic feet of air per minute to a dew point of −10° F.

This fully automatic Kemp Dryer, reactivated every 12 hours (or 22,800 cubic feet of air), has so far required no down-time or service at all! And, according to Mr. Glendon L. Smith, Unit Engineer at Cities Service, there is practically no pressure drop from the entering pressure of 285 pounds . . . further indication of Kemp quality and efficiency.

Kemp Dryers for Every Purpose

Kemp offers a variety of dryer models to meet all problems. Designed to dry air, gases or liquids to sub-zero dew points at low cost, they are constructed of quality materials and embody the engineering knowledge gained from Kemp's many years of experience. They are available with manual, semi-automatic or fully automatic tower reactivation. In addition, Kemp will prescribe the proper desiccant for each specific drying job. If you have a problem involving the removal of water from air, gases or liquids, contact Kemp now. For complete facts and technical information, write for Bulletin No. D-100.

KEMP
OF BALTIMORE

DYNAMIC DRYERS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • INERT GAS GENERATORS
SINGEING EQUIPMENT

THE C. M. KEMP MFG. CO.
405 East Oliver Street, Baltimore 2, Maryland

Street, Berkeley, Calif., for more information on the sliding-plate microviscometer.

●

Portable Cooler Is Lined For Taste-Free Water

This portable water cooler is now protected with Crystalining, a plastic lining that helps to keep drinking water and other liquids clear and taste-free. The bottom of the cooler is built to eliminate metal-to-metal contact. This construction reduces heat transfer. These water coolers come in 2, 5, 10, and 15-gal. sizes. **Write or call: Bettis Corp., 620 South Sixty-sixth Street, Houston, Tex., for more information on the Igloo portable water cooler.**

●

Grooved-End Pipe Coupling Is Flexible, Seals Tightly

These flexible couplings are stocked in sizes 1 to 8 in., with other sizes on request. The Alumiron coupling is available in either malleable iron or aluminum and is furnished with Buna N or Neoprene gaskets. For high temperatures a special silicone compound is supplied. For use on steel, aluminum, cast iron, wrought iron, and spiral-weld pipe, the Alumiron can be quickly coupled or uncoupled with two bolts which pass through the coupling halves. A tight seal is made easily by drawing up the two half housings with a socket wrench—this leak-tight seal increases as the vacuum or pressure increases up to 1,000 psi.

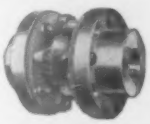
The Alumiron coupling's flexibility permits the pipeline to follow the terrain's dips and grades. It is now in use on long surface runs over rough, uneven country. It is used on service pipe at drilling rigs, christmas trees, stock and transfer lines, gathering lines, and

Coupling problem?
THOMAS will help select your coupling

FLOATING SHAFT
BMR—for heavy duty service where excessive misalignment is expected

DOUBLE FLEXING
DBZ—for high speed, heavy duty drives

SINGLE FLEXING
SS—for engine-driven generator sets, especially with outboard bearing



DOUBLE FLEXING
AMR—for engine and medium speed drives

Your Thomas Sales Engineer, backed by 40 years of coupling experience, will help you select the correct type Flexible Coupling from the Thomas catalog. Or, he will engineer special variations for unusual cases. For all practical purposes, properly installed and operated within rated conditions, Thomas Flexible Couplings will last *forever*.

NO LUBRICATION • NO MAINTENANCE • THERE ARE NO WEARING PARTS

Under load and misalignment, only Thomas Flexible Couplings offer *all* these advantages:

1. Freedom from backlash—torsional rigidity
2. Free end float
3. Visual inspection while operating
4. Smooth, continuous drive with constant rotational velocity
5. Original balance for life

Write for Engineering Catalog 51A and the name of the Thomas Flexible Coupling engineer nearest you

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

AXELSON PICTORIAL

PUMP RUNS CONTINUOUSLY FOR 32 YEARS, RODS 50 YEARS

The following information was taken directly from P. D. Quinby Oil Company's files on their Well #2, McKittrick, California (shown). On Jan. 12, 1922, an Axelson TL Pump 2″ (1¾″) with regular cast iron liners and regular steel plunger was run into the well. It ran 24 hours a day for 32 years at 9 strokes per minute. When pulled for the first time in June, 1954, liners and plunger were worn (after 307,152,000 plunger reversals) but balls and seats were in excellent condition.

A new Axelson pump was run back into the well on the same Axelson sucker rod string that had been installed originally in 1905 when the well was completed—over 50 years of continuous sucker rod service!

HASH STRIPES. C. E. "Earl" Gwin (right), Production Foreman for P. D. Quinby Oil Company, holds the barrel of the Axelson pump that saw 32 years of uninterrupted service. Orian Myers, well puller, sits beside the plunger assembly. Balls and seats showed very little wear. The new pump is strapped to the car.

MUSEUM PIECE. Lee Kulzer, Axelson District Manager, inspects the Axelson sucker rods which were installed in 1905 and are still going strong. The first metal rods were ¾″ and ⅞″ iron bars with bolt threads on each end. Bolt-threaded couplings held them together. When rods parted, the broken end was cut off with a hacksaw and the end rethreaded with a bolt-thread die. The rod was screwed into the coupling and run back into the well.

LEADERS. In front of the Axelson pump rack at the J&L store at Freer, Texas, are Lee Rodgers (left) and Bryan Weaver, Production Superintendent for the Estate of A. A. Buchanan. Rodgers opened this pump shop 22 years ago and for 5 years (1949-54) led all 90 stores in the J&L organization for sales of Axelson pumps and parts. Weaver was Superintendent for Magnolia in Electra, Texas, back in 1924 and used to buy 12 Axelson pumps at a time—"They were cheaper by the dozen, then," he says.

HARD WORKER. An Axelson Volu-Max (Maximum Volume) 2½" pump is being run in on the rods to lift 500 B/D of fluid with 30 bbls. of 24 gravity oil. Fluid level is at 900 feet. Cycle is 20 strokes per minute, 40" stroke. This well is in Trinity Field, Texas. Boone Bros. Oil Company is the producer. Volu-Max Pumps are recommended for this kind of hard, fast, high-volume, poorly lubricated pumping.

117 YEARS. These three old timers, caught chinning in the pump repair shop at Jones & Laughlin's Shreveport store, Louisiana, have been around the oil fields a few years. Hugh White (left) has been with J&L the past 38 years and 4 years with Gulf Oil prior to that. Cleon Worley (center), Axelson District Manager, has been with Axelson for 31 years, 6 with Continental Supply and 7 with Prairie Oil & Gas. J. A. Evans, Jr. (right) roughnecked for 3 years before starting on a 30-year career with J&L. It all adds up to 117 productive years in the industry.

No. 8

AXELSON MANUFACTURING COMPANY

Division of U. S. Industries, Inc.

6160 South Boyle Avenue, Los Angeles 58, California

Specify **AXELSON** *for*
Subsurface Pumps
Sucker Rods
Stuffing Boxes & Packing
for better production

Where to buy Axelson Production Equipment:

CALIFORNIA: *Axelson stores at Bakersfield, Coalinga, Huntington Beach, Long Beach, Orcutt, Santa Fe Springs, Taft, Ventura; Hickey Pipe & Supply Co. (Sucker Rods)* • **MID-CONTINENT:** *Jones & Laughlin Steel Corporation, Supply Division (Headquarters, Tulsa)* **ROCKY MOUNTAINS:** *Jones & Laughlin Steel Corporation, Supply Division; Great Northern Tool & Supply Co., Billings, Montana* • **CANADA:** *Jones & Laughlin Steel Sales Co. Ltd., Calgary; Dominion Oilfield Supply Co. Ltd., Calgary* • **MEXICO, D. F.:** *Wells Fargo & Co. Express, S. A.* • **RIO DE JANEIRO, BRAZIL:** *MAQUIP (Commercial de Maquinas e Equipamentos) S. A.* • **LIMA, PERU:** *Gross Equipment, S. A.* • **LA PAZ, BOLIVIA:** *Del Prado & Compania, Ltd.* • **BUENOS AIRES, ARGENTINA:** *Adrian Bolland & Cia., S. R. L.* • **BARCELONA, VENEZUELA:** *Servicios Industriales, C. A.* • **MARACAIBO, VENEZUELA:** *Servicios Industriales, C. A.* • **BOGOTA, COLOMBIA:** *Servicios Industriales, C. A.* • **TRINIDAD, B. W. I.:** *Industrial Agencies, Ltd.*

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MO 5-6809 UN 4-6441 HI 7-2396

OIL and GAS JOURNAL Showcase ..... OF NEW EQUIPMENT

waste disposal lines. **Write or call: Charles E. Manning Co., 4700 Clairton Boulevard, Pittsburgh 36, Pa., for more information on Alumiron couplings.**

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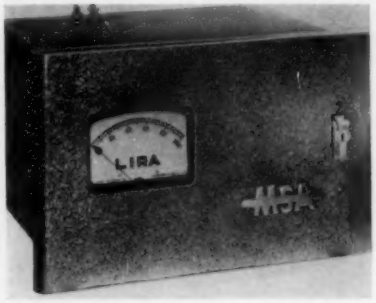


Gas Analysis by Infra-Red Aids Process Automation

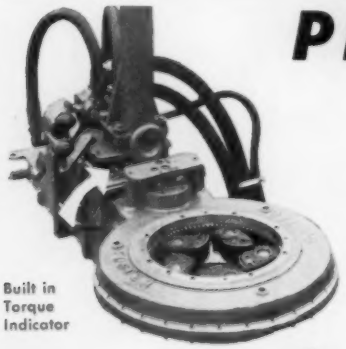
Gas contaminants in air and in other gases are being detected with infra-red light indicators. They also are being spotted with instruments which can be used to provide continuous quantitative records or automatic control of industrial processes.

These instruments can differentiate and select from a variety of similar compounds. They can monitor one of these streams in either large or small concentrations. They are ideal for process control. They have been used to prevent poisoning of catalysts in chemical and petroleum processing and to improve product quality by measuring continuously the impurities in a product stream, and to reduce the loss of product in waste streams.

Accurate infra-red analyses of the amount of propane and butane in natural gas before and after stripping are becoming important. Gas contaminants such as acetylene in ethylene, other contaminants in process streams of hydrogen in ammonia synthesis, and in hydrogenation plants are being measured by several infra-red analyzers having a sensitivity of a few parts per million.

The water contents of fuel gases, air, and combustion products also are being measured by these instruments. **Write or call: Mine Safety Appliances Co., 201 North Braddock Avenue, Pittsburgh, for more information on gas-analysis process instruments.**

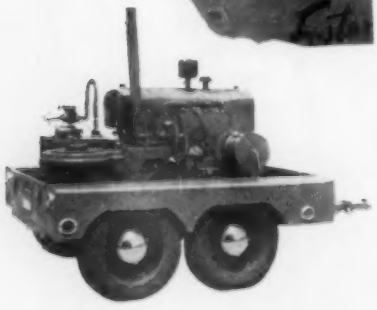
PREVENT PIPE DAMAGE



Built in Torque Indicator

Foster TUBING TONG

Pressure Relief Valve (Regulator)



The Foster Tubing Tong makes up every joint—uniformly—to precisely the tightness desired—thus assures proper tightening and prevents damage to pipe threads. To achieve the desired torque pressure you simply screw in the pressure relief valve until the torque indicator registers the desired torque, then set the valve lock nut. The torque pressure thus obtained is applied uniformly and automatically to every joint.

PREVENTS BITE

The tubing is never gripped on the bias. The tong is suspended on a LONG TONG HANGER, is counter balanced when installed, and moves up and down with the tubing. This feature not only protects the tubing against bite, but assures efficient operation with a very minimum of manual effort.

Specially designed dogs are another outstanding feature. They grip on the small or the upset, any size tubing from 2⅜" OD to 3½" OD without changing dogs. Extra dog sets are available for 1½" to 5½" pipe. This feature saves time and costs, and assures a positive, five-dog grip which minimizes tubing marking.

REDUCES MAKE-UP AND BREAK-OUT TIME BY TWO-THIRDS

The Foster Tubing Tong remains on the pipe for the entire trip, with no time lost in placing tongs on the pipe and removing them. Break-out time is reduced to 7 seconds, make-up time to 5 seconds—one-third the time normally required.

More and more major and independent producers are specifying Foster Tubing Tongs to prevent pipe damage, and contractors profit by the tremendous increase in speed and efficiency.

Write today for Foster Tubing Tong catalog.

Foster CATHEAD COMPANY
P. O. BOX 1351 WICHITA FALLS, TEXAS
2101 GRANT ST. PHONE 2-8[illegible]

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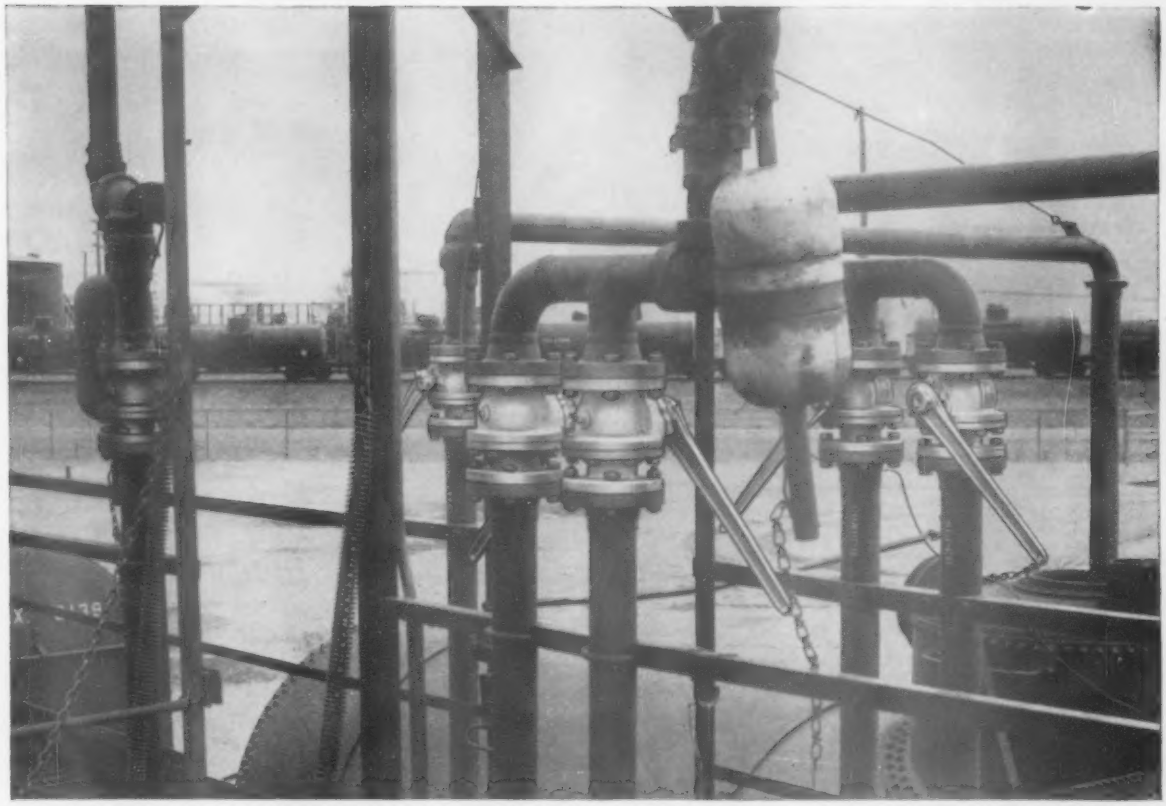
Langley Y Cia Srl ..... Buenos Aires, Argentina
East-West Oil Tools C. A. ..... Maracaibo & Anaco, Venezuela



He said leaking couldn't be stopped

...*but Rockwood Ball Valves stopped it!*

The resident engineer of a major oil company was skeptical when we told him about the exclusive features of Rockwood Ball Valves. It was impossible, he said, to keep racks free from messy oil conditions due to drippings from valves. But he agreed to replace his old style valves with Rockwood Valves.

He was surprised at the result — *absolutely no leaking from Rockwood Ball Valves.*

It's easy to see why Rockwood Ball Valves are leakproof when you examine them. You'll find—

Full Round Pipe Size Flow — no change in shape or volume of fluid stream — no turbulence — no minimum loss.

Quick Opening and Closing — only a quarter turn needed.

Longer wear resistance — Chrome-plated bronze ball withstands abrasion, pitting and scratching.

Leakproof Seal — pressure of fluid automatically positions ball against seat to form tight seal.

It works as good as it reads! Send coupon today for complete information. Rockwood Ball Valves come in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal industrial areas.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW

ROCKWOOD SPRINKLER COMPANY
1268 Harlow Street
Worcester 5, Mass.

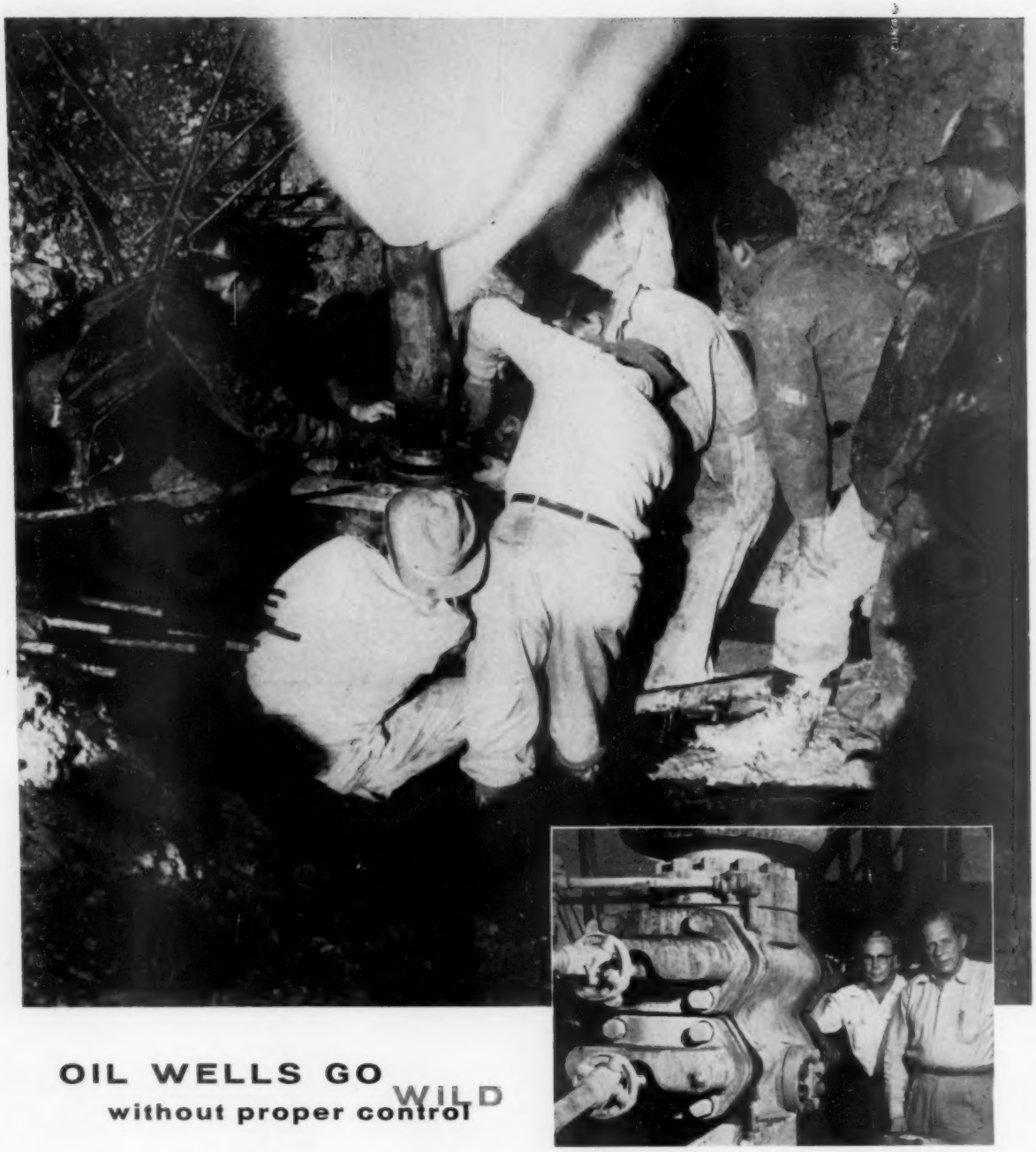
Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

Name.....

Title.....

Company.....

City.....Zone....State.....



OIL WELLS GO WILD
without proper control

Cameron developed the first successful Blowout Preventer right here in Houston over 35 years ago. It met with immediate success. Other superior products related to the control of extreme pressures followed and today the Cameron line includes the world's most complete range of drilling and completion control equipment.

While improving the line of completion control equipment Cameron developed a new forging process for the production of large and intricate steel forgings. Today this process has become an important part of Cameron's operation producing many unusual forgings not only for the oil industry but for a constantly increasing group of customers in ordnance and industry.

Houston is the center of Cameron's activities - plants, warehouses and representatives are maintained throughout the oil producing areas of the free world.

Cameron IRON WORKS, INC.
P. O. Box 1212-Houston, Texas

Export Office: 7912 Empire State Bldg., New York City. In England: Cameron Iron Works Ltd., Time & Life Bldg., New Bond Street, London W. 1 England.

OIL AND GAS JOURNAL

Showcase

- BULLETINS
- CATALOGS
- BROCHURES

The F-15 Triplex Pump is presented in the four-page Bulletin No. 466. This 2-in. stroke pump is the smallest of four of this type ranging up to a 5-in. stroke. Applications include water flooding, salt-water disposal, and other oil-field services. Its rating ranges from 6 to 15-hp. output with discharge pressures of 500 to 2,520 psi. Capacities range from 4.1 to 51.7 gal. per minute, depending on plunger size and speed of operation. Performance curves and specifications are given. **Write or call: National Supply Co., Two Gateway Center, Pittsburgh 22, Penn., for Bulletin No. 466.**

●

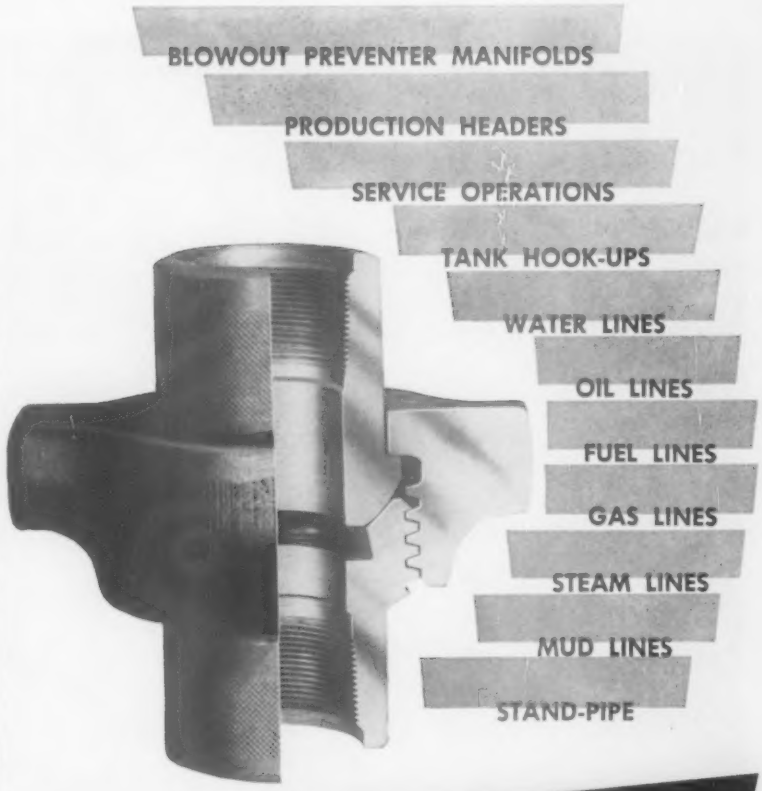
Lorain Offshore Cranes are described in an eight-page folder. The illustrated publication describes various models of cranes suitable for installation on mobile drilling platforms, permanent platforms, tenders and barges for handling mud, materials, pipe, personnel, seagoing gear, and supplies. Specifications, dimensions, tables, and mounting instructions are included along with a crane-selection chart. **Write or call: Thew Shovel Co., Lorain, Ohio, for the offshore crane folder.**

●

Woodfield Pipe Line Fittings are covered in this 20-page booklet. It presents two-color photographs, engineering drawings, and information tables. These tables include sizes, dimension, material, and weight of pipe fittings. The pipe threads mentioned are standard A.P.I. sizes. Specifications for spinning line assemblies and catline swivels are given. The booklet lists world-wide sales and service locations and representatives including Ideco. **Write or call: Woodfield Hoist & Associated Industries, Ltd., Frindsbury Works, Rochester, Kent, England, for Pipe Line Fittings booklet.**

●

Storage Tank Insulation is discussed in a 12-page booklet. Photographs show how insulation is used under different conditions. Insulations available include corrugated aluminum, galvanized metal, and bituminous felt. Tables present technical data on heat losses and ther-



YOU NAME THE JOB-
There's a WECO UNION to do it Better

• Wherever a union is required, you will find there's a Weco Union in the exact size and pressure to assure you positive leak-proof protection . . . provide fast make-up and break-out . . . last longer with less trouble . . . do an all around better job of sealing and service.

Ask for Weco Unions at your nearest supply store.

U-9-56

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HOUSTON, TEXAS

WECO®

Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

fmc

New QUAKER hose for hot air ducting cuts heat loss up to 57%

OUTSIDE JACKET SURFACE TEMPERATURE (DOUBLE JACKET) 170°F.
OUTSIDE JACKET SURFACE TEMPERATURE (SINGLE JACKET) 235°F.
INSIDE AIR TEMPERATURE 450°F.

Synthetic fabric jacket and silicone tube retain temperatures from upstream to downstream end

Made in continuous lengths up to 50′, this new Quaker hose easily withstands temperatures as high as +450°F; as low as −80°F.

As the above diagram shows, the hose keeps heat loss—and therefore energy loss—to a minimum. (Comparable outside temperature of ordinary hot air ducting material, such as stainless steel, would be about 400° F.). Both the silicone tube and the synthetic fabric jacket of Quaker's new hose hold the heat!

Other advantages? The hose is lightweight and fully flexible. And it resists abrasion.

Available in either single or double jacket, the hose comes in 1″ to 4″ I.D.'s. Sizes 1″ and 1¼″ I.D. can be made in 30′ continuous lengths; 1½″ to 4″ I.D. in 50′ lengths. The hose takes regular expansion and shank hose couplings.

Want more information? Write to: *H. K. Porter Company, Inc. Quaker Rubber Division, Philadelphia 24, Pa. or Quaker Pioneer Rubber Division, Pittsburg, Cal.*

HKP QUAKER RUBBER DIVISION
QUAKER PIONEER RUBBER DIVISION
H. K. PORTER COMPANY, INC.

mal conductivity. The booklet lists data needed to figure tank-heat losses. **Write or call: William Kenyon & Sons, Ltd., Chapel Field Works, Dunkinfield, Cheshire, England, for the Storage Tank Insulation booklet.**

●

Pulsation Dampeners. The 52-page Bulletin 56-8 illustrates the advantage of using pulsation dampeners installed on drilling rigs, at pipeline stations, in fueling systems, and on oil-well cementing trucks. Engineering data include specifications, recommendation charts, dimensional drawings, and a list of supply points. **Write or call: Gadco Products, Inc., Box 1211, Long Beach 1, Calif., for Bulletin 56-8.**

●

The Bichromator Analyzer is described in a four-page, two-color folder. It is a dispersive infra-red plant instrument for continuous single-component measurement (either gas or liquid). The folder describes the instrument and its operation. Its features and specifications are outlined. A schematic diagram of the instrument's optical layout and basic design is included. **Write or call: Perkin-Elmer Corp., Instrument Div., Norwalk, Conn., for the Bichromator analyzer folder.**

●

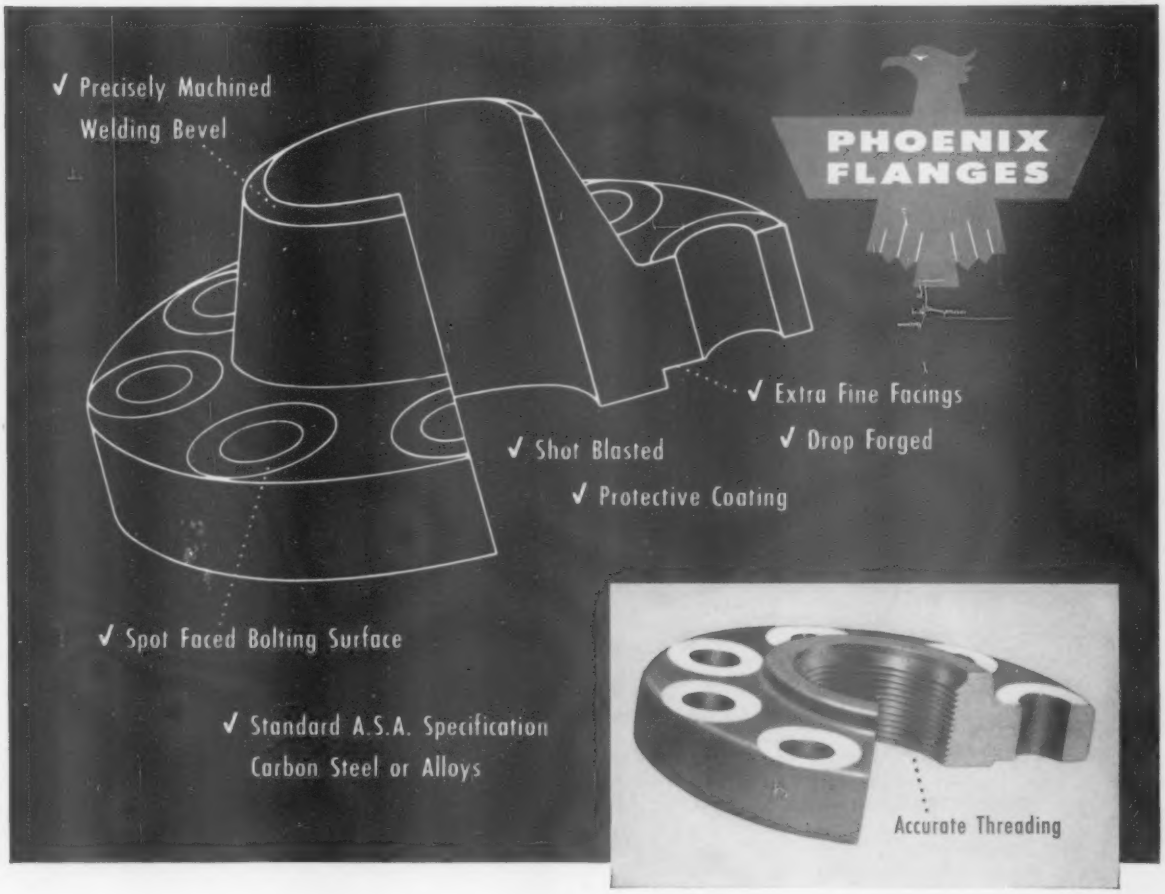
Guide for Selecting Valves, Boiler Mountings, Lubricating Devices is a 24-page reference booklet. Called valve guide Circular No. 555, it uses two-color cross-section drawings, tables, and technical information to assist in the selection of valves, boiler mountings, and lubricating devices. It is tab indexed for easy reference. **Write or call: Lunkenheimer Co., Cincinnati 14, Ohio, for valve guide Circular No. 555.**

●

Special Wire-Line Services are described in an information and price sheet which is effective January 1, 1957. This index-tabbed sheet includes bridging-plug service, junk-basket service, and other wire-line services. It accompanies other sheets on General Terms and Conditions and Index and Service Points which bring up to date the price folder for the **Western Co., Box 310, Midland, Tex. Ask for the price-folder revision sheets or the complete price folder if it isn't in your files.**

●

Low Differential-Pressure Transmitter is described in Bulletin 501. The bulletin describes the style H electric transmitter with ranges 0 to 2, 4, 6, 8, and 10 in. of water and with a working pressure of 50 lb. per standard in. gage.



PHOENIX QUALITY STANDS OUT ALL OVER

We needn't tell you what kind of life and service you demand from the pipe flanges you buy. The important thing to know is that you are ordering flanges which will be consistently high in quality. Phoenix drop-forged flanges *always* meet the highest quality and strength specifications. No one makes a better flange!

SPECIAL MACHINED FLANGES AVAILABLE
SPECIAL FACINGS • BORES • DRILLING • THREADING

Leading Manufacturers of Pipe and Tank Flanges and Commercial Forgings

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FLANGE AND FORGING DIVISION
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Use low-cost

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WEED KILLER

wherever weeds and grasses are a FIRE HAZARD!

Your "grassing" costs can drop as much as 80% when you use this weed killer! Savings in man-hours alone can be impressive when you consider that year-long results come from just one easy, DRY application of powerful Concentrated BORASCU. This granular, inorganic herbicide **destroys** most vegetation and **prevents regrowth** for long periods because it **remains active** in the root zone; satisfactorily meets all your requirements for safety.

NOTHING TO MIX

NO WATER TO HAUL

NONPOISONOUS

NONCORROSIVE TO FERROUS METALS

Want details? Write...

United States Borax & Chemical Corporation

PACIFIC COAST BORAX COMPANY DIVISION

630 SHATTO PLACE, LOS ANGELES 5, CALIFORNIA

DISTRIBUTORS LOCATED THROUGHOUT ... VENEZUELA.

Illustrations show the construction, dimensions, and operation of the transmitter. The style H transmitter makes possible the measurement of small differentials without undesirable hysteresis. It is inherently frictionless and has high reproducible accuracy over the usual operating span of 100 to 15 per cent. **Write or call: Burgess-Manning Co., Penn Instruments Div., 4110 Haverford Avenue, Philadelphia 4, Pa., for Bulletin 501.**

●

Fresh Water from Saline Sources. The newly revised Bulletin No. 3 describes the electric-membrane method of water demineralization. The 20-page illustrated bulletin provides design, performance, and cost data on electric-membrane plants that range in capacity from 2,500 to 2,000,000 gal. of demineralized water daily. They can use input water containing from 1,000 to 10,000 p.p.m. of totally dissolved solids. **Write or call: Ionics, Inc., 152 Sixth Street, Cambridge 42, Mass., for Bulletin No. 3.**

●

Roebling Wire Rope Slings and Assemblies. This new 52-page wire-bound Catalog A-931 speeds sling selection and ordering. It uses a simplified coding system that includes line drawings of the slings and fittings. These drawings tie in with capacity and size tables so that the correct assembly is easily determined. **Write or call: John A. Roebling's Sons Corp., Trenton 2, N. J., for Catalog A-931.**

●

Rotating Vacuum Transmitter for Automatic Chlorine Proportioning is described in the two-color, two-page Catalog 70-27. The rotating vacuum transmitter is used with a rotating flow meter and a chlorinator. The transmitted signal regulates chlorine feed in direct proportion to the main-line flow. Photographs and schematic drawings are included. **Write or call: Fischer & Porter Co., 906 Jacksonville Road, Hatboro, Pa., for Catalog 70-27.**

●

Norelco Electron Microscopes. A new 12-page catalog gives construction and operation data. In color, the new booklet includes photographs and covers the electron optical system, pumping unit, electronics, high voltage, column, gun, magnetic-beam alignment, condenser and aperture, beam wobbler, objective lens, and astigmator. **Write or call: Instruments Div., North American Philips Co., Inc., 750 South Fulton Avenue, Mount Vernon, N. Y., for the electron-microscope catalog.**

EQUIPMENT MEN . . . in the News

Richardson Promoted to New B S & B Process Post

The promotion of Warren E. Richardson to the newly created position of technical service, process equipment, has been announced by Floyd C. Myers, manager of sales and service, oil and gas division of Black, Sivalls, & Bryson, Inc. The new post, created to provide added facilities for broadened industry consultation on production problems, involving process equipment, requires up-to-the-minute knowledge of development work, product research and engineering on all B S & B process equipment.

Richardson joined B S & B in 1953 as district sales engineer for the Oklahoma City district and has served in that position until his recent promotion. Previously he had been construction engineer, pipeline foreman, and construction superintendent for Cities Service Gas Co., Oklahoma City.

Weatherford President Elected to YPO

Jess E. Hall, Jr., president of Weatherford Oil Tool Co., Houston, has been elected to the Young President's Organization, Inc. This is a national organization of young executives with headquarters in New York City. Self improvement through the exchange of ideas on modern management methods are the main objectives.

An executive is eligible for membership if he is elected president of his corporation before his fortieth birthday. If, like Hall, his firm is in the industrial field, the gross annual sales must be a minimum of $1 million.

Mission Names Lee as Regional Sales Engineer

Henry A. Lee has been named regional sales manager in Midland, Tex., by Mission Manufacturing Co. Lee, who has been with the Houston-headquartered company 1½ years, will work with both supply stores and industrial representatives who handle Mission products. He has been an application engineer with Mission and previously was with Baroid Division.

Eight Complete BJ Service Advanced Training Course

Shown here are eight recent graduates of the advanced training program of BJ Service, Inc., a subsidiary of Borg-Warner Corp. These men completed advanced training in specific managerial and supervisorial functions. They are: Werner Hartman and Lew Wylie, Mid-Continent area; Wally King, Lee Thomason, and A. D. Schmidt, Rocky Mountain area; Elmer Lobaugh, Pacific Coast area; Dell Taylor, Mid-Continent; Grover Thornton, Pacific Coast.

Homco Appoints York and Rogers as Store Managers

John York has been appointed by Houston Oil Field Material Co., Inc., as store manager at Kenedy, Tex., replacing D. M. Rogers. Rogers was transferred to Pearsall to replace A. R. King as store manager.

Western, Chemical Process Make Licensing Agreement

The Western Co. and Chemical Process, a division of BJ Service, Inc., have entered into a cross-licensing agreement on the new perforation sealing process for oil-well fracturing and acidizing. This announcement was made jointly by John B. Merritt, executive vice president and general manager of BJ Service, and H. E. Childs, Jr., president of Western.

Under the terms of the agreement, BJ Service will be responsible for licensing other oil-well service companies to perform these perforation sealing processes using the combined patent rights and technical development of both Western and BJ Service. The Western Co. will be primarily responsible for research and development of the improved equipment and techniques. Both companies will continue to offer the service through their established field outlets, Western identifying its service as perforation ball sealers and BJ Service-Chemical Process using the trade name, Select-O-Ball. Licensees of the process will be free to adopt their own trade names.

George Engine Announces Electromotive Appointees

Ed Henderson has been appointed assistant service manager for George Engine Co.'s electromotive drilling-rig

ED HENDERSON

WILLIS MILLER

equipment. Willis Miller has been named assistant sales manager in charge of electromotive drilling-rig equipment.

Henderson has had 10 years of field experience at George Engine in all phases of its service department. Miller formerly was with the Electro-Motive Division of General Motors Corp. He served Electro-Motive as a field instructor, technical writer and technical engineer.

Rockwell Begins New Valve Plant in Indiana

Construction has begun at Knox, Ind., on a new 35,000-sq.-ft. valve-parts plant for Valve Products, Inc., subsidiary of Rockwell Manufacturing Co. Located on a 20-acre site, the plant will be so constructed that further additions can be built in three directions.

According to W. F. Crawford, Valve

Products president, the new plant is expected to be completed in the first half of 1957. It will produce parts for Rockwell-Edward high-pressure, high-temperature valves and Rockwell-Nordstrom lubricated plug valves.

Sales Representatives Appointed by Win-Well

Lee Snodgrass, owner of Lee Snodgrass Co. of Los Angeles, and Waymon L. Davis and William R. Marler,

LEE SNODGRASS

W. L. DAVIS

partners in General Well Testing Co. of Shreveport, La., have been appointed as sales representatives for their respective areas by Win-Well Manufacturing Co., Los Angeles.

Snodgrass has many years' experience in the engineering and sales of valves, fittings, meters and other equipment in the oil, industrial, and chemical field. The Snodgrass organization will distribute the Win-Well product in California, southern Nevada, and New Mexico.

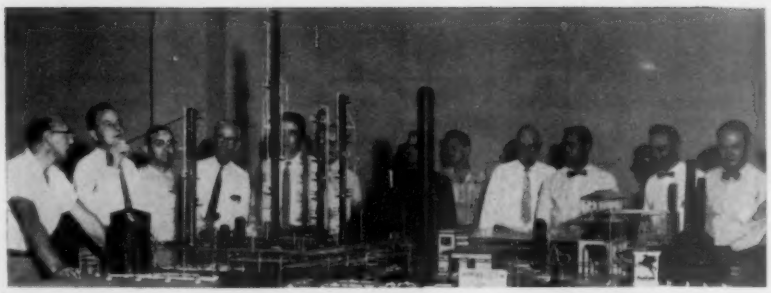
Both Davis and Marler were connected with Chicago Corp. before they formed their own company. General Well Testing Co. will represent Win-Well in East Texas, Arkansas, Mississippi, Alabama, and northern Louisiana.

Web Wilson Opens New Dallas Warehouse

Web Wilson Oil Tools, Inc., has announced the opening of a warehouse at Dallas, Tex., to serve the Mid-Continent and Gulf Coast areas. Hubert L. Arrowhead is in charge. Ray E. (Flash) Gorman, Mid-Continent division sales manager, also will make his headquarters at the new warehouse location.

Orbit Names North Texas Sales Representatives

David M. Alkire has been appointed North Texas field representative for Orbit Valve Co., according to L. E. Wallace, general sales manager. Alkire will headquarter in Wichita Falls and will work under the direction of James P. Bowling, district manager, Dallas.



Socony Representatives and Pritchard Designers Meet

Shown examining the three-dimensional model built by J. F. Pritchard & Co. are William Phillips, Pritchard; George Koutelas, Pritchard; Phillip Ball, Socony; Fred W. Irwin, Pritchard; A. R. Garling, Socony; Karl Puidak, Pritchard; Joseph Gieck, Pritchard; E. E. Anderson, Pritchard; E. F. Moore, Socony; B. A. Burdette, Socony; Melvin Morrison, Socony; William Sweeney, Socony.

Representatives of Socony Mobil Oil Co. were recent visitors to the offices of J. F. Pritchard & Co., Kansas City, Mo. Engineers from the Socony organization met with Pritchard designers to finalize piping and plant layout for a 9,000-bbl.-per-day fixed-bed catalytic reformer at Augusta, Kans.

Using a process designed by Socony Mobil engineers, J. F. Pritchard & Co. will complete the engineering and construction of the unit which is part of Socony Mobil's current expansion program.

Pritchard's Fred W. Irwin is project engineer and will be assisted by Joseph Gieck.

Aztec Starts Producing New Line of Pumping Units

FLOYD HUBERT

A new line of beam-type pumping units is being introduced early this year by Aztec Manufacturing Co., Fort Worth, according to Floyd Hubert, president. Initial production will be concentrated on smaller units up to 7,000-lb. A.P.I. polished rod load capacity. The line will be rapidly expanded to a full range of sizes.

Aztec's new plant in the Westcliff industrial district in South Fort Worth is being enlarged to handle production of pumping units. Aztec is establishing sales and service offices covering Texas, Oklahoma, New Mexico, Kansas, Louisiana, and Arkansas.

Officers of Aztec Manufacturing are Floyd Hubert, president; Rue Hestand, executive vice president; H. W. Mayerhoff, vice president; J. Stafford Page, secretary-treasurer; and Fred Barnum, sales manager.

Schlumberger Names Rock Springs Manager

Robert E. Kurdle has been appointed manager of Schlumberger Well Surveying Corp.'s district office at Rock Springs, Wyo.

Kurdle joined Schlumberger in 1951 and has served as a field engineer in Farmington, N. M., and Casper, Wyo.

Macco Names Meripol as Ass't. Sales Manager

The appointment of R. B. Meripol as assistant sales manager has been announced by Macco Oil Tool Co., Inc. Meripole's oil-field background includes service with Standard Oil Co. of California; Parkersburg Rig & Reel Co.; and 4 years as California sales engineer for Emsco Manufacturing Co., distributors for Macco Oil Tool Co. in the California area.

Walker Well Heads Names Vice President, Sales Mgr.

G. JENNINGS

The election and appointment of Grady Jennings as vice president and sales manager for Walker Well Heads, Inc., Tulsa, has been announced by D. C. (Clint) Walker, president. Jennings comes to Walker Well Heads from Rubarite, Inc., where he was sales manager. He formerly was with Fluid Packed Pump Co., Sargent Engineering Corp., and Mudco Valve, Inc.

Bethlehem Supply Makes Personnel Changes

C. C. CRIDER

The appointment of C. C. Crider as general manager of stores for Bethlehem Supply Co. has been announced by G. A. Tompson, president of the company. Succeeding Crider as central division sales manager will be Arthur Weber, Jr., who has been district manager of the West Texas - New Mexico district since 1953. Replacing Weber will be C. R. McNair, who has been division machinery sales representative in the Gulf Coast division office at Houston.

Crider has been a division sales manager for Bethlehem Supply Co. since 1939. His experience in the supply business dates back to 1922, at which time he helped organize Taubman Supply Co., which was purchased by Bethlehem in 1937. In this newly created position, Crider will supervise the operation of all Bethlehem stores. He will continue to headquarter in the general office at Tulsa.

C. R. McNAIR

A. WEBER, JR.

Coincident with this appointment, Bethlehem will move its central division office to the Continental Bank Building, Fort Worth. Weber, who becomes division sales manager at this point, joined Bethlehem Supply in 1942 as a sales engineer in the Tulsa office. He has served as special representative for the West Texas-New Mexico district, assistant district manager and district manager of the same district.

McNair joined Bethlehem Supply in 1948 and in 1949 was promoted to machinery sales representative. He was promoted to division machinery sales representative and transferred to the Gulf Coast division office in Houston in 1955, remaining in that assignment until now. McNair's headquarters will be in Midland.

McCullough Names Collum, Opens Olney Location

R. N. COLLUM

The appointment of Roy Neal Collum as district sales manager for the Illinois basin and the opening of a new service location at Olney, Ill., have been announced by McCullough Tool Co.

With McCullough 5 years, Collum was transferred from Magnolia, Ark., where he was branch manager. Prior to this, he was sales engineer in Shreveport. Collum will coordinate McCullough sales in Illinois, Kentucky, and Indiana, establishing his headquarters in McCullough's Carmi, Ill., branch.

Stanley Zurek is in charge of operations at the new branch at Olney. This branch is equipped to provide bullet and jet perforating, radiation logging and all wire-line services.

Chrysler Appoints Calif. Industrial Engine Dealer

Power Tractor Co., Oxnard, Ventura County, California, has been appointed Chrysler industrial-engine dealer. R. M. Power operates the company.

Indian Drilling Mud Names Doughman Sales Engineer

Harry C. Doughman has been appointed sales engineer in the Tulsa area for Indian Drilling Mud Co., Oklahoma City. He has been a corrosion engineer with Pipe Line Anode Corp., Tulsa, before joining the Indian organization. Doughman will establish an office in Tulsa.

Oilwell Appoints Field Representatives

Appointment of Thomas G. Higgins as field representative of U. S. Steel Corp.'s Oil Well Supply Division at Williston, N. D., has been announced by R. L. Armstrong, Rocky Mountain area manager of Oilwell. Robert J. Mitchell has been named field representative at Estevan, Sask., according to W. A. Weir, Canadian area manager of the division.

Higgins was employed in 1955 at the division's Casper, Wyo., store. Mitchell joined Oilwell in 1951. He later served as field representative at Swift Current, Sask., and Virden, Man. In January 1956 he was named store manager at Estevan, the position he held prior to his present appointment.

Perrault Names Northwest Field Representative

K. FOWLER

Kenneth Fowler has been appointed Northwest field representative of Perrault Equipment Co., Tulsa, according to W. O. Dixon, owner of the firm.

Fowler has had long experience in manufacturing, pipeline and construction work dating back to 1931 when he began working on a pipeline in western Kansas. Prior to joining Perrault, he was with Northside Manufacturing Co., Minneapolis.

Kobe Promotes Manney

Cecil S. Manney of Kobe, Inc., Mid-Continent division, has been promoted from chief inspector to district sales representative serving Oklahoma and North Texas.

New Garland Plant Dedicated by American Meter

More than 500 gas and petroleum-industry leaders from the Southwest attended the dedication of this new American Meter Co. sales offices and plant on a 10-acre site in Garland, Tex. Guided plant tours were a feature of the program. Until recently the company had been located in Dallas. This unit will make or assemble orifice meters and a wide range of control equipment for the oil, gas, and chemical industries, W. G. Hamilton, Jr., company president, announced.

The Garland plant is the sixth new plant to be built by American Meter since 1951. Another was opened December 7 in Fullerton, Calif. This makes a total of 10 plants in this country and Canada.

Harold W. Wahl is sales manager for the Garland area. He is manager of the southern division, Westcott & Greis, Inc., division of American Meter. His headquarters will be in Garland. James W. Burg is Garland factory manager.

somewhere in the world we analyzed

THE GOLDEN FOOT

Somewhere . . . sometime during October 1956, we met and analyzed *The Golden Foot* — the one-millionth sample to be evaluated by Core Lab personnel.

Naturally, we would have liked nothing better than to have appropriately publicized the precise foot, the area, the formation, and the client. But with core being run in *thirty-nine* Core Lab installations, day and night, such identification was impossible.

The Golden Foot may have been run in one of our new labs at Farmington, McAllen, Long Beach, or Craig. It may have been analyzed in Lafayette, Edmonton, Bartlesville, or Monahans. Whenever and wherever it occurred, the fact remains that a million feet of analysis is a significant symbol of progress — not only for Core Lab but for the industry, as well.

Every year since 1936, more and more operators have turned to core analysis as the source of *virgin data*—basic reservoir facts which directly influence technical and financial steps throughout the productive life of a field.

To Core Lab, The Golden Foot represents a plateau of stability — and the opportunity to broaden its research, advance the technical background of its employees, add new services, and to maintain its position as the industry's greatest single source of petroleum reservoir knowledge.

THE ONLY FULLY INTEGRATED PETROLEUM RESERVOIR ENGINEERING FIRM

CORE LABORATORIES, INC.

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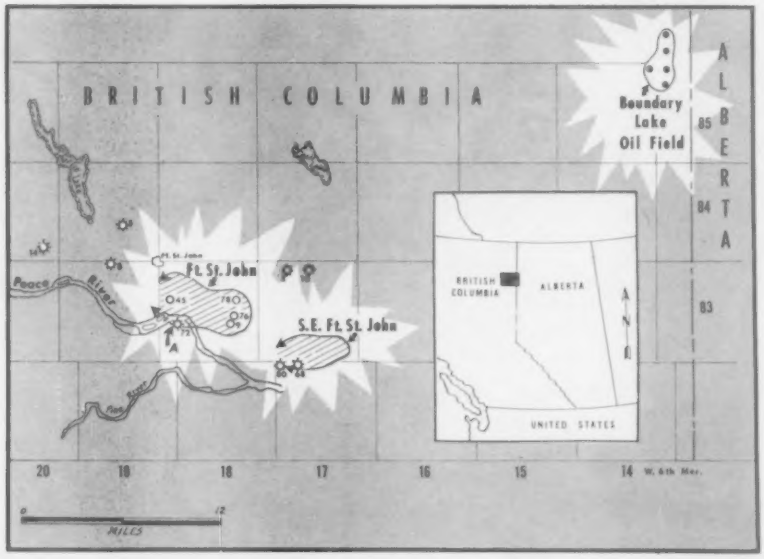
PETROLEUM RESERVOIR ENGINEERING

DALLAS, FT. WORTH, HOUSTON, CORPUS CHRISTI, M. ALLEN, SAN ANTONIO, MIDLAND, ABILENE, PAMPA, MONAHANS, LUBBOCK, LOVINGTON, SHREVEPORT, TYLER, EL DORADO, OKLAHOMA CITY, WICHITA FALLS, TULSA, ARDMORE, BARTLESVILLE, LIBERAL, ARKANSAS CITY, GREAT BEND, LAFAYETTE, NEW ORLEANS, HATTIESBURG, DENVER, STERLING, CASPER, WORLAND, KIMBALL, NEBR., FARMINGTON, BAKERSFIELD, LONG BEACH, CALGARY, EDMONTON, REGINA, VENEZUELA, S. A.



NORTHEASTERN BRITISH COLUMBIA recently passed a milestone in its oil development, as production exceeded 1,000 bbl. daily. Shaded areas are Fort St. John gas fields.

B. C. Looks Ahead

. . . and likes what it sees

by Frank J. Gardner

BRITISH COLUMBIA, in October, reached the first plateau toward becoming a major oil source when it reported an average daily production of 1,111 bbl. So far, only two fields have been placed on production, but all signs point to a busy oil decade ahead for this westernmost province of Canada.

A campaign in reverse . . . The first oil discovered was at Boundary Lake field (northeast corner of map) in 1955 . . . or more accurately the first oil **intentionally** discovered. At Fort St. John, the only other field, oil shows of commercial value had been found early in the drilling campaign in 1951. But Fort St. John operators were conducting a reversal of the usual campaign; they were looking for gas, not oil. Pacific Petroleums, Ltd., principal company in the field, was set on establishing enough proven gas reserves to justify the great gas pipeline now under construction from the Peace River area to the Pacific Northwest. Oil was found, but passed up in favor of gas. Now, however, the pipeline is almost finished, and the oil potential of the field will receive more attention.

FORT ST. JOHN AREA TODAY

Pay—	Wells	Potentails
Cadomin	2 gas	Max. 29 M.M.c.f.
Triassic A	9 gas	Max. 23 M.M.c.f.
Triassic A & B	6 gas	Max. 52.5 M.M.c.f.
Triassic C	3 oil	200-300 bbl.
Triassic D	11 gas	Max. 100 M.M.c.f.
Permo-Penn	9 gas	Max. 71 M.M.c.f.
Permo-Penn Stray	1 oil	50 bbl.

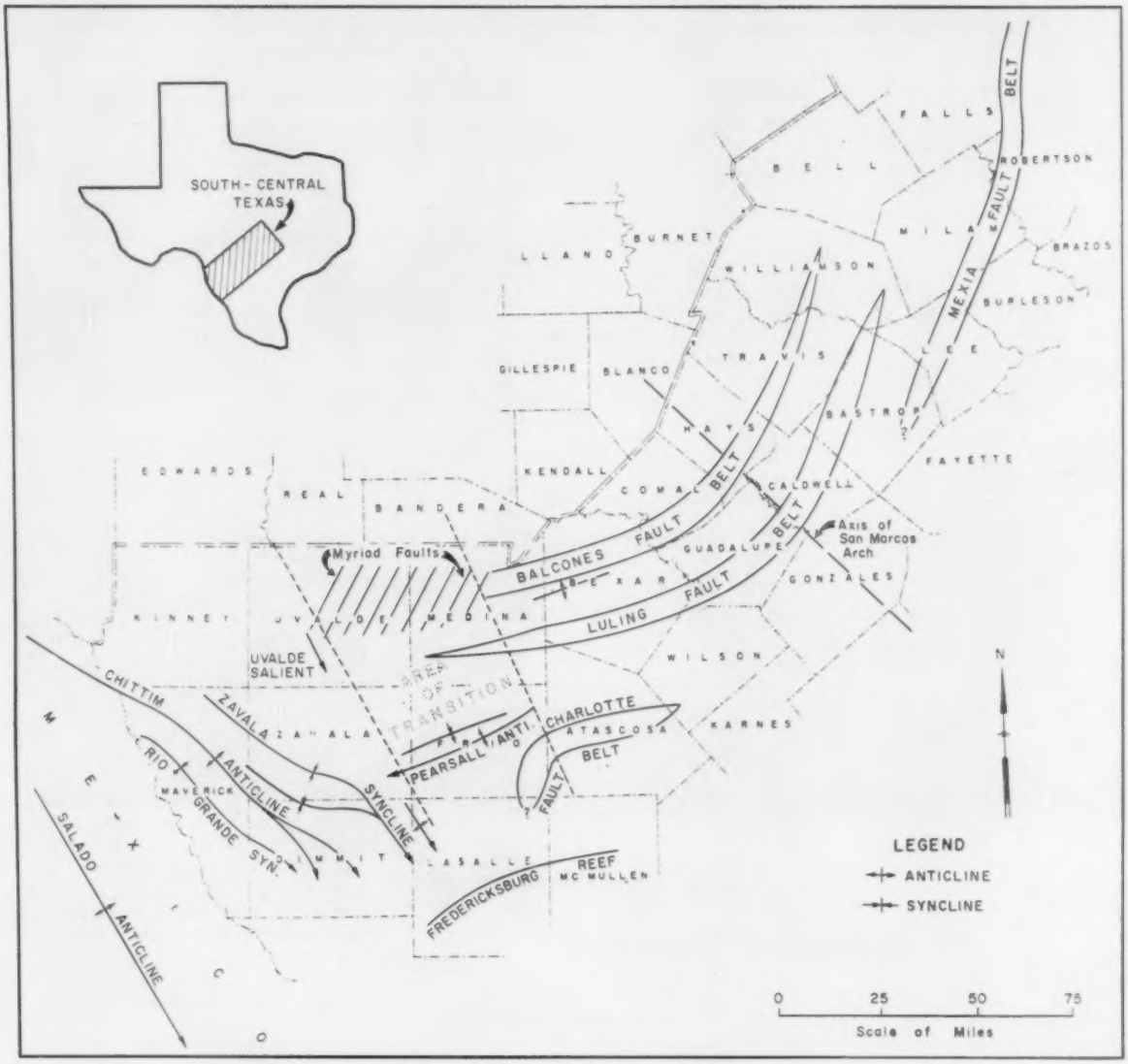
Boundary Lake, the only officially designated oil field in B.C., was found by the Northern Foothills Agreement Group, composed of Texaco Exploration Co.; British American Oil Co., Ltd.; Mobil Oil of Canada, Ltd.; and Shell Oil Co. There are now five wells in the field, producing about 21,000 bbl. per day from an average 17 ft. of pay sand in the Schooler Creek-Triassic. The oil is 34° gravity, and comes from a depth of about 4,300 ft. The field produced only 582 bbl. in 1955, but this year has flowed 64,419 bbl. (up to November 1). One well is now drilling in the field.

Sprints steadily ahead . . . In contrast, activity in Fort St. John field is humming along, with eight rigs kept constantly busy. Pacific Petroleums runs production string on a well, moves off the drilling rig, and uses a workover rig for acidizing, fracturing, and completing. Thus drilling and completion are steadily sprinting ahead. The company now is concentrating on 1-mile stepouts on the flanks of the structure, and some notable extensions have been made recently. In the main Fort St. John area, one of the most important of these was well 72, a gas well and the first test south of Peace River (A on map). In the Southeast Fort St. John field, wells 68 and 80 are late extensions to the south and west; they are Permo - Pennsylvanian and Cadomin-Cretaceous producers respectively.

Pacific now has finished 37 gas wells and 4 oil wells in the two fields (see tabulation). The combined open-flow capacity of the gassers stands at 850 M.M.c.f. daily; of this, 170 M.M.c.f., or 20 per cent, is considered net producible. The Triassic oil wells in the east end of the main field (wells 9, 76, and 78) are 200-300-bbl. producers, while the lone west-end Permo-Penn oiler (well 45) is good for about 50 bbl. Oil and gas have been found in seven distinct pay horizons of Permo-Penn, Triassic, and Lower Cretaceous age.

Toward unknown rewards . . . How big the Fort St. John area will be is still anybody's guess. The structure is a big anticline, elongated northwest-southeast, and consists of several domes along its axis, separated by shallow saddles. It was discovered in 1951 by surface mapping and subsurface study of two dry holes; later, seismic surveys were run throughout the area, and some core drilling was done. But the true extent of the uplift is yet unknown. At least two oil zones and eight major gas zones have been identified, ranging in age from Cretaceous to Devonian. The 14,000 ft. of sedimentary section may yield even more reservoir possibilities as drilling continues.

British Columbia is just beginning to exploit its petroleum resources, but given a few more productive years like 1956, this latecomer province, where one well out of every two is a hit, will emerge as an oil source every bit as important as Alberta.



STRUCTURAL FEATURES of South Central Texas. Fig. 1.

Here's a bird's-eye view of

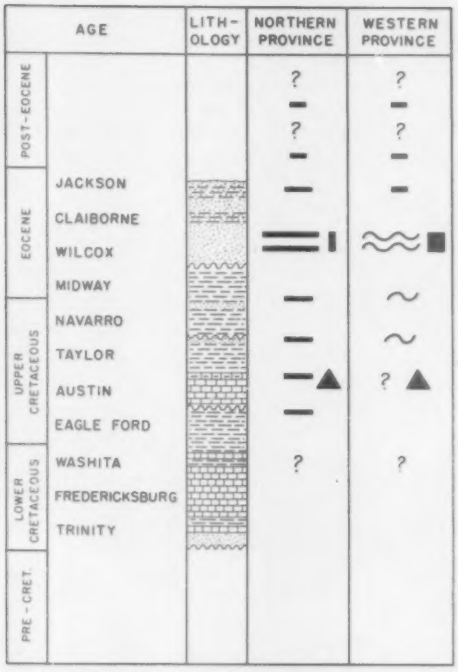
South Central Texas' Faults and Folds

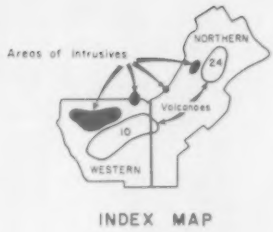
by Phillip Fowler

THE term South Central Texas applies to a 100-mile-wide arcuate belt extending from the Rio Grande northeastward to Brazos River (Fig. 1). It embraces the geologic provinces of the upper Rio Grande embayment, the greater San Marcos arch and the western approaches to the East Texas embayment. It is part of a gently deformed mobile belt that exhibits an interesting pattern of superficial deformation of Mesozoic and Cenozoic age.

This article is intended to give a bird's-eye view of Mesozoic and Cenozoic trends and not to deal with individual features. No attempt has been made to measure extension or shortening, or to quantify stress and strain. Rather, this is a brief introduction to the structure of South Central Texas and an invitation to further quantitative work.

Author is geologist, Shell Oil Co., Tyler, Tex. This paper was read at the sixth annual meeting, Gulf Coast Association of Geological Societies, San Antonio, 1956, and is presented here through courtesy of the G.C.A.G.S. and Shell Oil Co.





INDEX MAP

LEGEND

Major unconformity
Carbonates
Shale
Sandstone
Normal faulting
Folding
Igneous intrusion
Volcanism

(Breadth of symbol denotes relative intensity of process.)

GENERALIZED TIME TABLE of deformation and igneous activity. Fig. 2.

Major Structural Features

Fig. 1 shows the axis of the San Marcos arch. The axis of the Rio Grande basin in the Cretaceous rocks is approximately the axis of the Chittim anticline and shifts eastward in the Eocene rocks toward the axis of the Zavala syncline. The arch and the basin are gentle positive and negative features of subregional dimensions within the greater Gulf Coast depositional region.

These features are measured in terms of thickness of sedimentary rocks deposited and preserved per unit time. Accordingly they are rather nebulous terms that distinguish generally the relatively negative from the relatively positive tectonic elements. It is unprofitable to attempt to fix boundaries of these tectonic elements precisely.

The major fault belts of the San Marcos arch contain all the largest normal faults in South Central Texas. These principal faults have vertical displacements of 500 ft. or more. Between the major belts shown on Fig. 1 are many smaller faults ranging in displacement from a few feet to about 250 ft. They strike generally parallel to the major fault belts.

Balcones belt . . . The arcuate Balcones fault belt consists chiefly of large discontinuous coastward-dipping normal faults. The northern limit of significant Balcones faulting is in central Williamson County, and the western limit is in Uvalde County. It is of particular significance that the western end of the Balcones belt is a fan-shaped area which contains a very great number of tiny fault blocks.

On a large scale the Uvalde-Median sector looks like a broken mirror. The maximum displacement along the Balcones faults is in Hays and Comal counties, where individual faults have as much as 500 ft. of displacement at the surface.

Luling belt . . . The largest and best known of the Luling faults are the landward-dipping normal faults that trap oil in the Austin chalk and Edwards limestone in Guadalupe and Caldwell counties. Some faults have maximum displacements of the order of 500 ft. At its western end, in Medina County, the identity of the Luling belt is obscured in the poorly known area that merges northward with the complex western end of the Balcones belt.

Charlotte belt . . . The Charlotte fault belt is probably the best known of the great fault systems of South Central Texas because of the extensive and well documented drilling that has taken place during the past 10 years.

The Charlotte belt is two-sided: On the southern or downdip side is a series of en echelon landward-dipping faults ranging up to 700 ft. of displacement at the 8,000-ft. level; on the northern side is a parallel en echelon system of less well-known complementary coastward-dipping faults with displacements of 500 ft. or more at depth. The average breadth of the Charlotte fault belt is about 5 miles. Many small faults in the graben areas are both coastward and landward-dipping.

An odd feature of the Charlotte belt is the abrupt southward bend in its trace at the Atascosa-Frio County line. In Atascosa County, the belt trends slightly north of east; in Frio County, the trend is nearly north-south.

Pearsall anticline . . . Northwest of the Charlotte fault belt is the southwest-plunging Pearsall anticline, which has a short normal fault of 250-ft. displacement (down-to-the-northwest) on its northwestern flank. A pronounced doubly plunging syncline flanks the Pearsall anticline to the northwest, and the southeastern limb exhibits normal regional coastward dip.

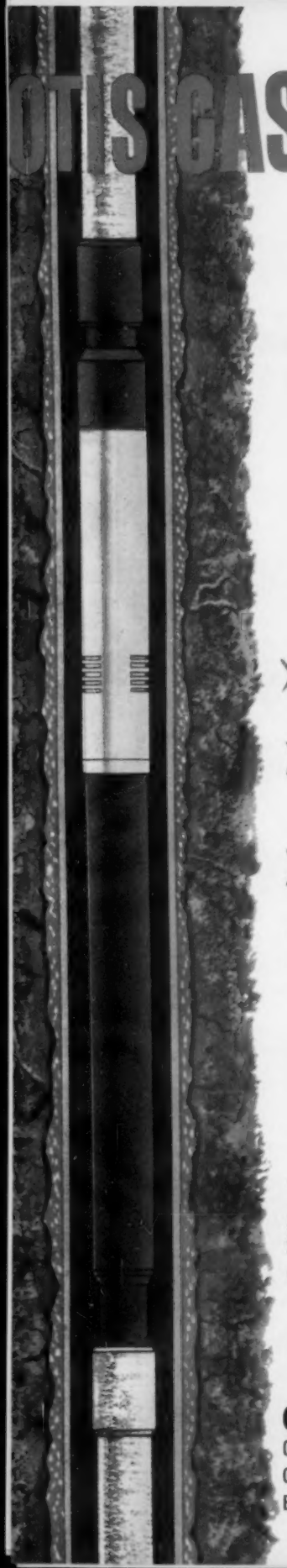
This extensive cuesta-shaped fold is anomalous in that it is the only feature of its type in South Central Texas, if we except the smaller faulted Culebra anticline in northern Bexar County. The fold appears compressional, but the net effect of the fault and the fold seems to be one of slight crustal extension. The strike of the anticlinal axis is parallel to the Balcones, Luling, and Charlotte fault belts and transverse to the fold axes in the Rio Grande embayment.

Mexia belt . . . The poorly known major fault belt extending from central Bastrop County in a direction slightly north of east through Lee and Milam counties is a southwestern extension of the Mexia fault belt of East Texas. As emphasized by Weeks (1945), the Luling fault belt is separate and offset from the southern projection of the Mexia fault belt.

Surface, well, and geophysical data show that the southern Mexia fault belt is a mirror image of the Charlotte fault belt, each occupying a similar position on opposite flanks of the San Marcos positive.

Like the Charlotte belt, the Mexia fault belt contains en echelon up-to-the-east and down-to-the-east faults, with intervening complexly faulted graben areas. Details of structure are wanting as relatively few wells have been drilled, but the displacement on the larger faults is comparable with that of faults in the Charlotte belt.

Rio Grande embayment . . . The upper Rio Grande embayment is strikingly different structurally in its lack of large regional faults. The faults that are there, are short, discontinuous, and small in displacement. Generally, structural features in the embayment are broad low-relief southeast-plunging anticlines whose axes trend parallel to the axis of the embayment. The most



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prominent folds are illustrated in Fig. 1.

The largest of the anticlines is the Chittim anticline which is flanked by the Zavala syncline and the Rio Grande or Eagle Pass syncline. Another feature evident to the surface geologist has been called the Uvalde salient. Most of the remainder of the folds have not been formally named in the literature. The pronounced coastward plunge of all these folds is, of course, a function of continued subsidence of the Gulf Coastal Plain throughout Cenozoic time.

Age of Movement

Criteria are few by which to date the formation of the structural features. Mostly they are indirect and negative. First, there is no indisputable evidence that local differential movement did occur during the deposition of the Lower Cretaceous beds. Moreover, if folding or faulting had occurred during the deposition of this great mass of carbonates, there should be consequent sedimentological irregularities.

None are observed, except apparent thickening of Washita units resulting from steep dip on the downthrown blocks of certain large faults.

The Lower Cretaceous rocks comprise a generally simple transgressive series deposited in a basin gradually subsiding in the direction of the Gulf of Mexico. In later early Cretaceous time, the edge of the Continental Shelf extended in a southwesterly direction from central McMullen County across southern LaSalle County. A narrow rudistid reef marked the edge of the shelf in Fredericksburg time.

The reef is at a large angle to the axes of the anticlines described previously (Fig. 1). This is considered fair evidence that the folds are post-Fredericksburg, as it appears unlikely that a reef, being sensitive to depth of water, would grow in a direction transverse to axes of uplift.

By late Eagle Ford time certain faults in the Charlotte belt had experienced minor movement. Abnormal thicknesses of Eagle Ford shale are observed on downthrown blocks close to the fault traces. Similar data demonstrate additional episodes of fault movement throughout late Cretaceous and early Cenozoic time.

It is probable that movement along faults of the Luling, Balcones, and Mexia belts was roughly contemporaneous with the Charlotte faulting. The Pearsall anticline exhibits differential movement in rocks at least as old as Austin age.

The latest fault movements in South Central Texas are at least as young as later Eocene, as faults cut beds of

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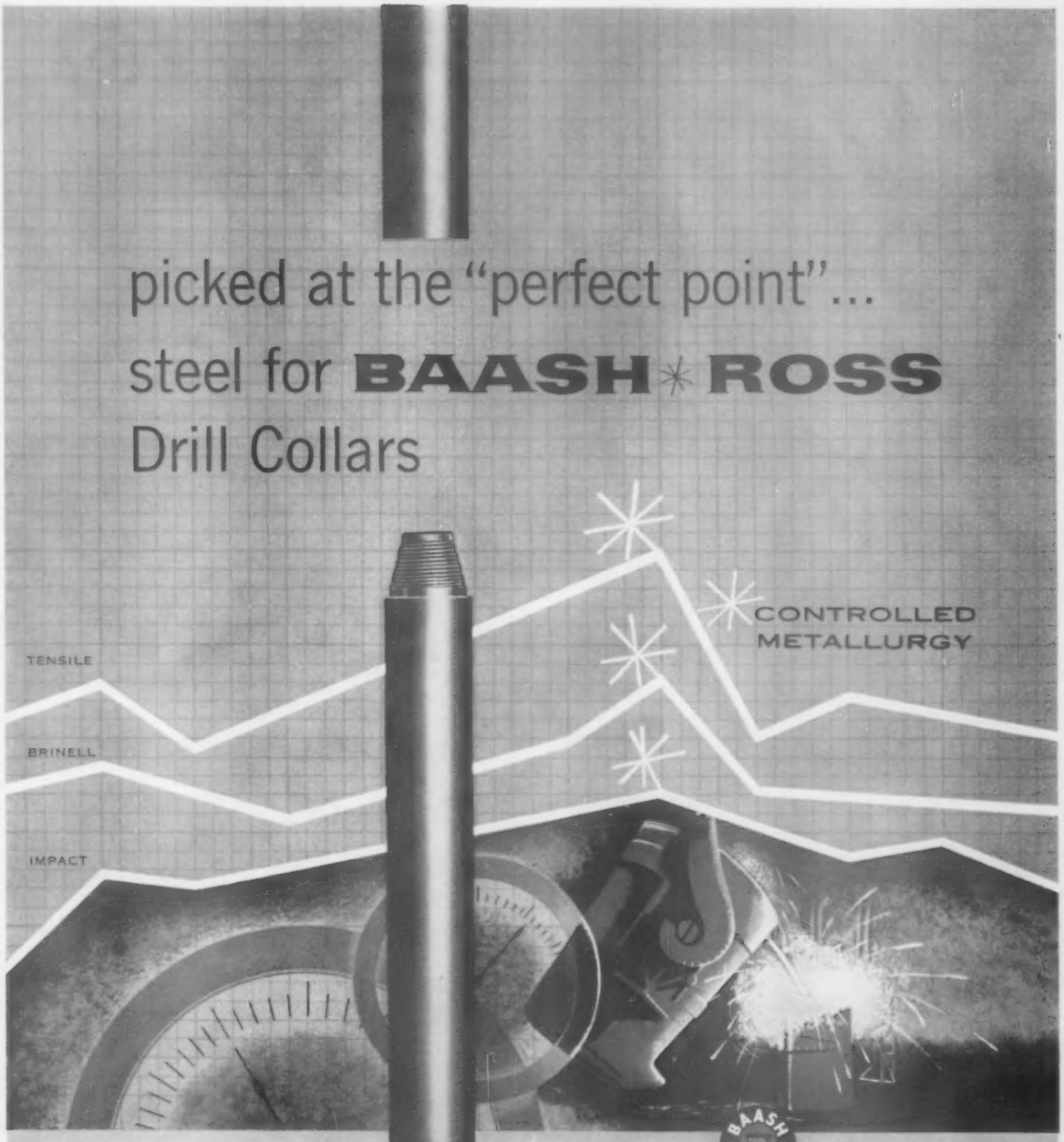

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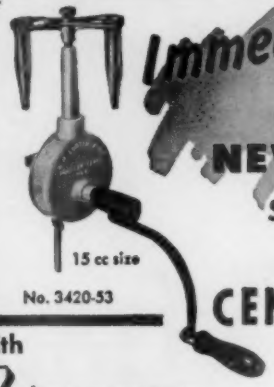

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the Claiborne group at the surface. It is possible that certain faults may have been active from fairly recent time.

Dating the folding in the upper Rio Grande embayment is less straightforward. The Chittim anticline appears to be at least as old as late Taylor for certain buried sand bodies in the later Taylor rocks conform in shape to the anticline (M. L. Smith, personal communication).

Movement continued at least until late Eocene time. Claiborne units at the surface are gently folded. The upper Rio Grande embayment is a feature manifested chiefly in the Eocene rocks. Some time between late Eocene and Recent, the upper Rio Grande embayment became tectonically relaxed, and minor normal faulting ensued.

Probably the maximum growth of faults and folds in South Central Texas took place during the deposition of the great flood of Wilcox clastics. Nearly half the displacement on some large faults in the Charlotte fault belt occurred between the deposition of the Midway shale and shale beds in the Claiborne group. Fig. 2 is a schematic time table of crustal deformation in South Central Texas.

Analysis

The upper Rio Grande embayment folding resulted in slight shortening of the superficial crust; the normal faulting across the San Marcos arch lengthened the crust. Quantitative expression of the strains in the folded area and in the area of normal faulting is not attempted here. Within each area the pattern of strain appears from inspection to be relatively homogeneous.

Qualitatively, it is helpful to visualize the structural map of South Central Texas as a two-dimensional view of a shallow strain field in the earth. The strain field can be described as extensional in the San Marcos arch area and compressional in the Rio Grande embayment. In Fig. 1, the area of transition denotes a belt in which the strain field changes in character from extensional to compressional.

Within the area of transition are the abrupt bend of the Charlotte fault belt, the unique Pearsall anticline, and the shattered area at the western end of the Balcones fault belt. It is suggested that these structural features, which have no counterparts elsewhere in the region, are expressions of the nonhomogeneity of the strain field in the area of transition.

It should be emphasized that the description of the strain field must be confined to its shallow aspect. Control data are fairly abundant above a depth of 1 mile, inadequate and scattered down to 2 miles in depth, and rare below 2 miles. Where information is available, it is observed that the angles of dip of major faults range from about 65° at shallow depths to above 40° at depths of 7,500 ft., more or less.

The faults have higher dip angles in the predominantly sandstone section of the Cenozoic and lower angles in the Upper Cretaceous shale.

It has been suggested that differential compaction of the shale subsequent to faulting acted to decrease the angle of dip. In addition, the regional subsidence toward the Gulf of Mexico must be a minor factor in decreasing the angle between a horizontal surface and the surfaces of the landward-dipping faults, about which we have the most data.

Information on the dips of fault surfaces in the Lower Cretaceous carbonate rocks is insufficient for generalization. A rigorous treatment of relative movement among points (i.e., of strain) in masses of rock in South Central Texas, therefore, will require discrimination of the factors attributable to diagenesis and those of tectonic origin.

The nonspecialist will probably be impressed chiefly by the fact that extensional and compressional stress existed side by side in South Central Texas. Doubtless, similar stress relations have been and are present in other mobile belts marginal to orogenic areas. It is manifest that the Sierra Madre Oriental orogenic belt was superim-

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posed upon only a part of the preexisting basin of subsidence and deposition. The pattern of strain in South Central Texas seemingly demonstrates a measure of independence between the subsidence and the folding of a geosyncline.

Igneous and Metamorphic Activity

The commonly observed, but little understood, relations between abnormally high temperature, magmatic movement, folding, and faulting, are justification for setting down a few such observations about South Central Texas. Fig. 2 shows the general distribution of igneous bodies and their time relations.

Igneous activity . . . In late Austin and early Taylor time, the sea floor in South Central Texas was spotted with submarine volcanos which exploded great quantities of volcanic ash composed of olivine basalt. The volcanics were altered subsequently to clay minerals, loosely called serpentine.

The volcanic episode immediately preceded the earliest recorded folding in the Rio Grande embayment and the volcanoes were contemporaneous with widespread normal faulting in the northern San Marcos arch area. The positions of known volcanoes of Austin-Taylor age seem to have no significant relation to known faults. By the end of the volcanic episode, the sediments deposited in the Texas Gulf Coast had changed from principally carbonates to almost exclusively clastics.

The next igneous episode is dated only as early Cenozoic (Lonsdale, 1927), possibly Wilcox in age. It saw the intrusion of dikes, sills, stocks, and plugs of generally basaltic composition, including nephelite basalt, phonalite gabbra, olivine basalt, and limburgite. The greatest number of intrusives is in the northern part of the Rio Grande embayment, particularly in Uvalde and Kinney counties. Whether the intrusives accompanied the climatic folding in this province or were emplaced shortly before or after is unknown. Some of the ultramatic rocks may belong to the Austin-Taylor volcanic episode.

No further igneous activity is known in South Central Texas, but major volcanism is recorded in Oligocene rocks in adjacent Southwest Texas. The surface Catahoula (Bailey, 1926) and subsurface Frio beds contain trachytic and andesitic agglomerate, bombs, and ash.

Presumably this volcanism occurred after the relaxation of compressive stresses in neighboring South Central Texas.

Metamorphism . . . Humble Oil & Refining Co. 1 Bandera County School Land in Maverick County, and Shell Oil Co. 1 Plumly in Zavala County, both encountered thermally metamorphosed rocks of probable Jurassic age. Fine to coarse-grained siltstone, sandstone, conglomerate, and shale below about 13,000 ft. display a gradual downward increase, both in number and in size, of fresh porphyroblastic shreds of sericite. It is reported (Gruner, 1944) that sericite forms at temperatures of the order of 300° C.

The thermal metamorphism in the Humble test appears to be accompanied by dynamic metamorphism increasing in intensity with depth. This test is on the crest of the Chittim anticline and bottomed in low-grade metamorphics and volcanics that may be pre-Jurassic. Although some of the metamorphism may be Jurassic and/or pre-Jurassic, it is tempting to speculate that the dynamo-thermal metamorphism occurred during Eocene time as an accompaniment of the folding of the Chittim anticline and the intrusion of dikes and plugs in adjacent Kinney and Uvalde counties. The thermal aspect of the metamorphism is clearly Mesozoic or Cenozoic, as Shell 1 Plumly has conspicuous sericite in rocks that are Jurassic or early Cretaceous in age.

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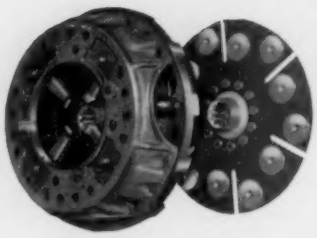

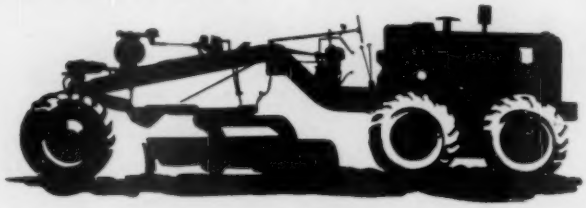

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Under the assumption that the metamorphism was of Eocene age, the reciprocal temperature gradient at that time must have been about 15 m. depth per degree Centigrade. The average gradient in both the deep tests today is 34 m. depth per degree Centigrade, or less than half the Eocene gradient.

Relatively little rock has been eroded since Eocene time and no evidence exists to indicate that the upper Rio Grande embayment was greatly depressed (as under the tectogene hypotheses). Therefore we can speculate the Eocene folding was accompanied by a regional upward rise of geoisothermal surfaces, aided by aqueous emanations.

The practical consequences are that little or no porosity remains in the rocks affected by the regional metamorphism. Again we are faced with the tantalizing puzzle of the physical relationship of folding and abnormal rock temperature.

Lonsdale (1927) emphasized that relatively little contact metamorphism is evident along the borders of the Uvalde intrusives exposed at the surface today. It is probable that the relatively cold country rock chilled the magma at shallow depths. The intrusive bodies probably played no part in metamorphism, for the deeper rocks of the Chittim anticline were metamorphosed without the presence of magma.

The heat may have been liberated partly by the transformation of mechanical to frictional energy during folding of the anticline. The water essential to effecting the transformation of clay and feldspar to sericite could have been connate water that was gradually expelled from the sedimentary pore spaces as an upward rising front while the anticline was in compression.

In short, whatever was the ultimate cause of the folding, the dynamothermal metamorphism may have been a local effect beneath a local fold.

Conclusions

In the early part of Late Cretaceous time, the broad platform area of Central Texas on which great thicknesses of Lower Cretaceous limestone were laid down was broken by normal faults into many blocks. The faulting reached a climax in Wilcox time. Accompanying the destruction of the relatively stable depositional platform was a change from dominantly carbonate to almost exclusively clastic sediments.

The clastic deposition resulted from a net increase in topographic relief between the continent and the Gulf of Mexico or, in other words, the Gulf Coastal Plain began to sink more rapidly in Late Cretaceous time than had been the case in Early Cretaceous time. In Late Cretaceous time, orogeny commenced in northeastern Mexico, and its influence extended about three counties deep into adjacent South Central Texas.

The folding also reached a climax in approximately Wilcox time and was succeeded by minor normal faulting in the upper Rio Grande embayment. A belt in Frio, Zavala, Medina, and Uvalde counties contains structural features that appear to be transitional between the folds typical of the Rio Grande embayment and the faults characteristic of the San Marcos arch.

At least three general aspects of the deformation in South Central Texas have parallels in other mobile belts:

1. The orogenic episode occupies a time interval that is short compared with the phase of subsidence and sedimentation.

2. The folding seems to generate deep hydrothermal fronts that cause metamorphism as they rise through the sedimentary section.

3. Orogeny seeems not to be a predetermined phase of a mobile belt, but rather a relatively sudden unheralded event, the focus and trend of which is

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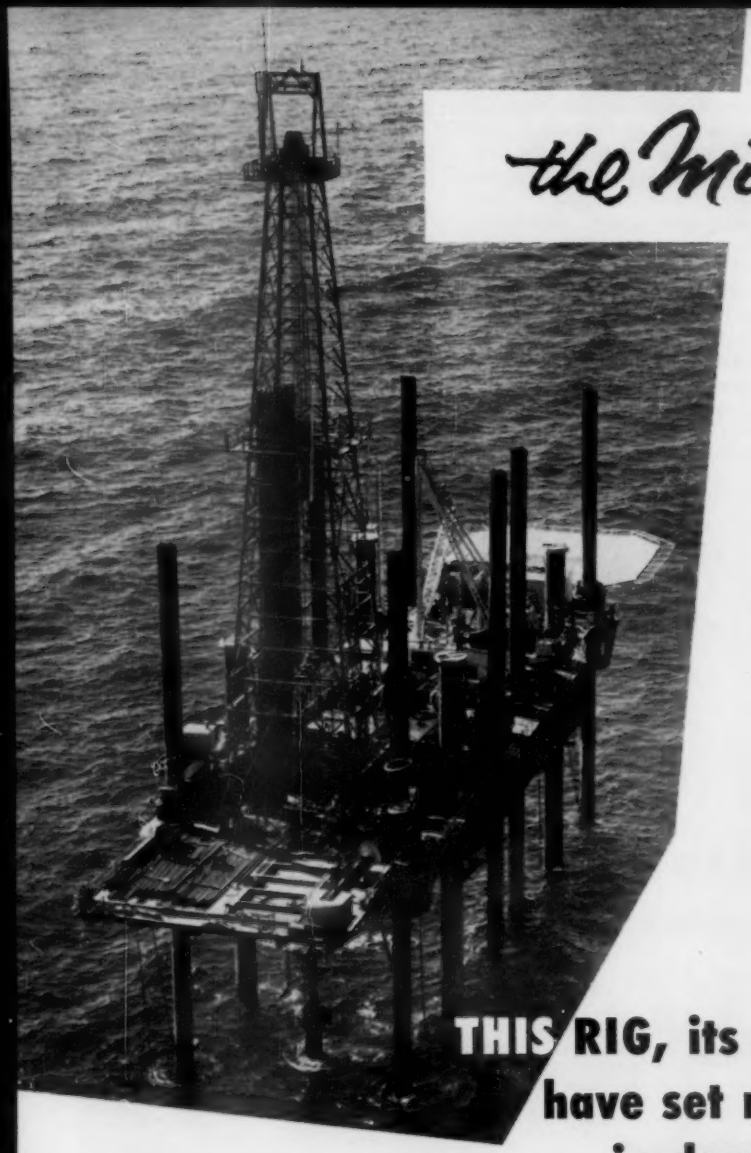

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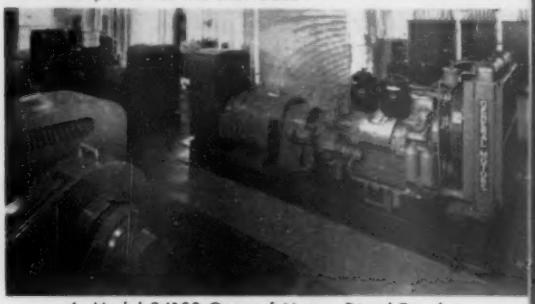

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independent of preexisting extensional stresses in the mobile belt.

References

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EXPLORATION HIGHLIGHTS

SOUTH TEXAS

TEXAS OFFSHORE

Seventh Offshore Field Opened in Gulf

Texas' seventh offshore field is indicated at Arkansas Fuel Oil Corp. 1 State Tract 950-S, 8 miles southeast of Flour Bluff off Neches County in the Gulf of Mexico.

The indicated discovery tested on 12/64-in. choke, gaging an estimated 6,000 M.c.f. of gas on the first test; 4,700 M.c.f. on the second test. Recovery of distillate on drill-stem test was 100 ft.

SOUTHWEST TEXAS

Starr County Gas Strike Shut In

Pure Oil Co. 1 H. Guerra, a new gas discovery 15 miles northeast of Rio Grande City in Starr County, was completed as a shut-in well from perforations at 3,405-11 ft. This well is located 1,550 ft. west-southwest of M. E. Andres, Ltd., 1 H. R. Maresh, an oil discovery from the 3,580-ft. sand at West Rincon field.

TEXAS GULF COAST

Dual Oil and Gas Discovery in Hardin

Atlantic Refining Co. 1 H&TC fee is the dual discovery of oil and gas for new South Segno field, 5 miles northeast of Votaw in Hardin County. The well, located in Section 220, H&TC Survey 220, A-810, flowed 76 bbl. of oil per day on 8/64-in. choke from perforations in the Yegua sand at 7,142-50 ft. The sand is the Yegua Y-6. The well also flowed gas at 6,793-6,810 ft. in the Y-5 sand at the rate of 2,600 M.c.f. per day with distillate on ¼-in. choke.

SOUTH LOUISIANA

SOUTH LOUISIANA

Union Completes Timbalier Bay Oil Discovery

Union Oil Co. of California has a new oil discovery in Terrebonne Parish's Timbalier Bay area at No. 1 State Lease 2826, between Caillou Island and Lake Barre fields.

The Union discovery flowed 160 bbl. of 35°-gravity oil and 212 M.c.f. of

Exploration This Week

South Texas	171
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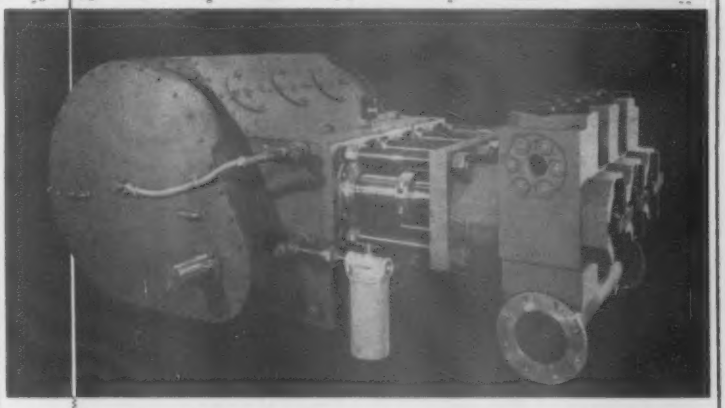

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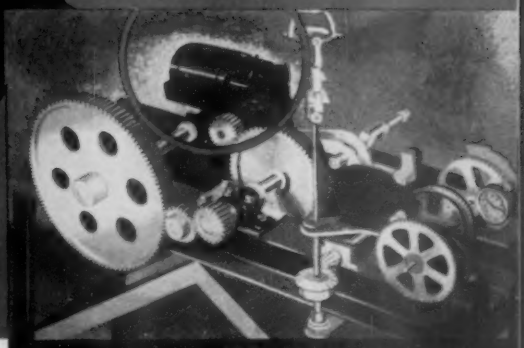

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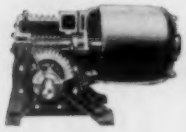

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gas per day on completion from perforations in the Miocene sands at 11,938-48 ft. Earlier tests at 11,834-44 ft. made 325 bbl. of oil per day. The well will be dually completed later.

Potential Taken at Iberia Gas Strike

Potential was taken at C. G. Glasscock-Tidelands Oil Co. 1 Cocke-Goodrich, Iberia Parish gas discovery 4 miles north of Bayou Long field. The well flowed 32.9 bbl. of distillate and 1,878 M.c.f. of gas per day on 10/64-in. choke from perforations at 11,567-11,607 ft.

The new producing area is being called East Bayou Pigeon field.

Confirmation Well Completed in Acadia

A confirmation well in the southwest extension area to Northwest Branch field in Acadia Parish was completed as a gas-distillate well, the field's second. It is Kilroy Co. and F. A. Callery, Inc., 1 Annie T. Frey, southwest offset to the discovery well.

The well flowed an estimated 2,500 M.c.f. of gas per day with a spray of distillate on 12/64-in. choke from perforations at 10,901-11 ft. Well is now closed in for connection. It is located in 15-8s-1e.

New Oil Production In Grand Coulee Area

Sun Oil Co. is opening a new shallow oil sand in Acadia Parish's western flank of the Grand Coulee area, 14-8s-1w. The 1 Mayo Miller.

Extension Well at Duson Completed by Sunray

Sunray Mid-Continent Oil Co. has completed a high pressure gas well in South Duson field, Lafayette Parish. The 5 Mary McConnell is a confirmation well to the 1 Bolo-Mex. discovery well. The new well flowed at the rate of 2,600 M.c.f. per day with 7 bbl. of distillate through perforations at 13,274-87 ft. Flowing pressure is 9,800 psi. Shut-in tubing pressure is 10,400 psi. Gas-distillate ratio is 142,857:1.

Gas Flows at Palmetto Bayou Oil Field

Humble Oil & Refining Co. opened gas-distillate production in Palmetto Bayou oil field, Terrebonne Parish. The gas discovery well is 1-E LaTerre Co. in 6-19s-13e. It is now shut in for potential.

The well flowed 182 bbl. of distillate and 7,800 M.c.f. of gas per day on ¼-in. choke from perforations in the new sand at 11,984-90 ft. Oil production in the field is below 13,000 ft.

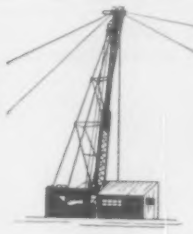
New Gas Pay Added At South Thornwell

A new gas-distillate pay sand was added to the southwest flank of South Thornwell field in Jefferson Davis Parish by Pan American Production Co. and Austral Oil Exploration Co., Inc. The 3 Eddie Benoit et al flowed 100 bbl. of 42.8°-gravity distillate and 5,000 M.c.f. of gas per day on 12/64-in. choke from perforations at 10,315-35 ft. Location is in NE¼ 36-11s-5w.

LOUISIANA OFFSHORE

Grand Isle Block 40 Discovery Completed

The Grand Isle Block 40 wildcat discovery south of the field offshore from Jefferson Parish was officially completed dually from perforations at 10,412-22 ft. The well is Continental Oil Co. 1-B State Lease 948. It flowed 308 bbl. of 32.6°-gravity oil on 10/64-



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in. choke; it also flowed 312 bbl. of 32.7°-gravity oil on 10/64-in. choke from perforations at 9,956-78 ft.

Ship Shoal Block 135 Area Adds Oil Strike

Gulf Refining Co. and Humble Oil & Refining Co. completed the 4-A OCS 0462 as a new oil discovery in the Ship Shoal Block 135 area off Tennebonne Parish.

The well flowed 345 bbl. of 30.9°-gravity oil per day on 10/64-in. choke from perforations at 10,770-85 ft. The discovery well is 29 miles offshore in 103 ft. of water.

MID-CONTINENT

KANSAS

Lansing Strike Reported Near Hill City in Graham

Imperial Oil of Kansas has a pool discovery prospect at 1 Robinson, SW SW NE 17-9s-23w, 2 miles southwest of Brush Creek pool and 7 miles southwest of Hill City in south-central Graham County.

Recovery on a drill-stem test in the Lansing-Pennsylvanian at 3,692-3,709 ft. was 900 ft. of clean oil in 1 hour. Another test at 3,818-32 ft. recovered 3,100 ft. of oil. Drilling continues to contract depth.

Hunton Discovery Due At East Reno Wildcat

Westpan Hydrocarbon Co. has a possible lime oil discovery at its 1 Swanson in SE SE NW 22-23s-5w, 2½ miles northeast of Bacon pool and 2 miles east of the city of Hutchinson in eastern Reno County.

Recovery on a drill-stem test in the Hunton lime at 3,738-44 ft. was 600 ft. of gas, 6 ft. heavily gas-cut oil, 150 ft. muddy gassy oil, and 60 ft. muddy gassy watery oil. Recovery on a second test at 3,744-50 ft. was 390 ft. of gas, 90 ft. gas-cut oil, 33 ft. of muddy gassy oil, and 117 ft. of mud and salt water.

A reworked exploratory test in northwestern Reno County, White & Ellis 1 Wisby in NE NE NE 18-22s-9w, 3½ miles north of Zenith - Peace Creek pool and 13 miles west of Nickerson, is on pump after swabbing and flowing an average of 8 bbl. of oil per hour.

Barber Assured New Gas Discovery

Byard Bennett 1 Schiff, a gas discovery well in SW SW NW 11-32-11, 1½ miles north of Highway pool and 4 miles east of Medicine Lodge, flowed gas on drill-stem test and then caught fire, destroying the rig. Fire is out and a new drilling rig is on location.

Viola Discovery Flows Oil in Barber

A Barber County wildcat is flowing oil on tests of the Viola at 4,557-71 ft. The discovery well is Aylward Drilling Co. 1 Walker, SE SE NE 21-30s-15w, 1 mile northwest of Sun City pool in the northwestern part of the county.

Ellis Discovery Waits For State Tests

Coppinger Drilling, Inc., and T&M Oil Co. 1 Scurlock in SE SE SE 20-15s-16w, 2½ miles northwest of Beeching pool in Ellis County, is waiting on state test after swabbing 4 bbl. of oil per hour from conglomerate perforations at 3,431-36 ft.

OKLAHOMA

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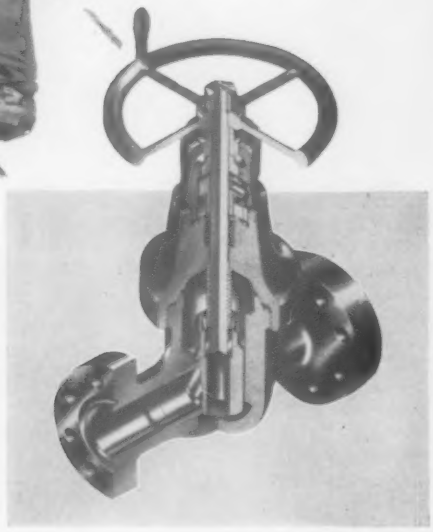

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producing area at West Moore, Cleveland County; flowed 215 bbl. of oil per day from unconformity sand perforations at 7,750-60 and 7,788-93 ft. on 12/64-in. choke; from the Hunton at 7,938-8,020 ft. the well flowed 125 bbl. per day on 12/64-in. choke. The discovery well was a Hunton producer. The unconformity sand is a new pay.

Distillate Show Hit At Woodward Wildcat

A wildcat in Woodward County, northwestern Oklahoma, recovered a distillate show with gas from perforations at 8,270-80 ft. The indicated discovery well, which, if successful, would open the second field in this county, is Tidewater Oil Co. 1 Church, SE SE SW 11-22n-20w. The distillate flow on the test was 1 bbl. per hour. Gas gaged 2,450 M.c.f. per day.

Testing Gets Under Way at Woods Discovery

Gulf Oil Corp. 1 Shade in SE SW 31-25n-14w, Woods County Hunton lime discovery, is testing. The first test in the Hunton at 7,120-28 ft. got 78 bbl. of oil with 82 bbl. water in 24 hours. After squeezing and perforating the well recovered 7 bbl. of new oil and 35 bbl. load in 8 hours on swab test. Latest test recovered 39 bbl. of oil on swab in 8 hours.

High Gilcrease Oil Flow Reported at Okfuskee

Olin Oil & Gas Corp. completed the 1 Mulley in NE NE SE 33-12n-10e, outpost well south of Okfuskee County's North Blakely field. The well flowed new oil at the rate of 1,176 bbl. per day on ½-in. choke from Gilcrease sand at 2,966-74 ft.

Sinclair Well Opens Dewey County to Oil

Sinclair Oil & Gas Co. has completed 1 A. M. Kunc, rank wildcat 8 miles southwest of Taloga in Dewey County.

The discovery well, located in C SW NE 11-17n-18w, was completed flowing 67 bbl. of 48.5°-gravity oil through ¾-in. choke in 8 hours from perforations in the Oswego lime at 9,159-93 and 9,201-13 ft. after acid treatment.

The well also yielded shows on a test of the Cherokee lime zone at 9,284-92 ft. Total depth was 14,467 ft.

The discovery is near the center of a 5,800-acre block owned by Sinclair.

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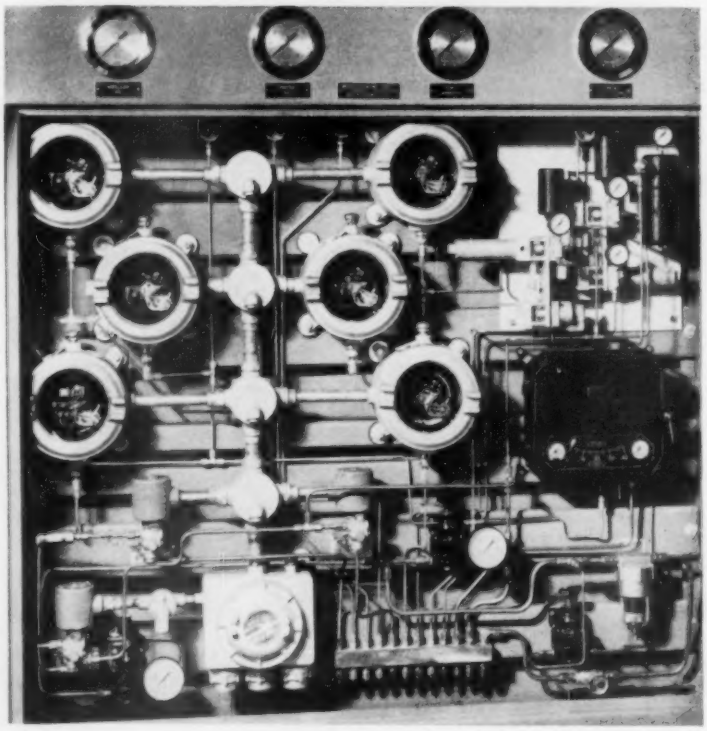

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WEST TEXAS-NEW MEXICO

Pecos County Has Indicated Discovery

A basal Permian oil discovery is indicated for Pecos County, 8 miles southwest of Imperial. El Cinco Co., Ltd., 1 W. L. Blaydes et al in 50-10-H&GN swabbed 25 bbl. of new oil in 24 hours from perforations at 5,283-93 ft.

Upper Clearfork Oil Flows in Winkler

Texas Pacific Coal & Oil Co. 5-B-4 Brown & Altman in 25-B5-PSL, a 7,600-ft. test ¾ mile southeast of Emperor Ellenburger gas production in Winkler County, flowed oil from the upper Clearfork sand. Drill-stem test was at 6,636-6,728 ft.

Pucket Report

Gulf Oil Corp. took potential at 3-A Jerusha Robbins in 35-126-T&St. L. Survey, 1¼ miles northwest of Devonian production in Puckett Multipay field, Pecos County. Gas flowed at the rate of 14,000 M.c.f. per day on

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½-in. choke from open hole at 10,436-10,675 ft. On 22/64-in. choke it made 8,500 M.c.f. daily. Location of this well is 25½ miles southeast of the city of Fort Stockton.

Second Dual Well Finaled at Bakke

Bakke multipay field in Andrews County added its second dual completion last week with production from the Wolfcamp and Pennsylvanian. The well is Continental Oil Co. 2 V. L. Grady in 22-A-44-PSL, ¼ mile east of the discovery well, finaled flowing dually 909 bbl. of oil.

Gage from the Wolfcamp at the 2 Grady was 369 bbl. of oil; from the Pennsylvanian it flowed 540 bbl. Continental is readying for 1-A V. L. Grady as a ½-mile north outpost to Wolfcamp and Pennsylvanian production in the field.

Glasco North Adds Third Devonian Well

Glasco North-Devonian field in Gaines County added its third producer and a southeast extension well. Plymouth Oil Co. 2 L. L. Butler, 29-19A-PSL, 17 miles northwest of Andrews, was completed for a flowing calculated daily potential of 2,128 bbl. of oil.

Second Well Added To New Schleicher Field

A new Permian field with no name in Schleicher County added its second producing well. R. H. Murray, Trustee, 2 Mrs. C. C. West in 78-A-HE&WT, 1 mile west of Eldorado, was completed pumping 83 bbl. of oil per day. Production is from perforations at 2,198-2,209 ft.

Strawn Discovery Seen At Garza Wildcat

A wildcat well in Garza County is assured Strawn production. Oil was recovered on two drill-stem tests at Paul C. Teas 1-A J. B. Slaughter in 31-1-Jasper Hays Survey, 5 miles southwest of Post, Tex.

Recovery on the first test at 8,279-94 ft. was 7,125 ft. of oil and 100 ft. of mud-cut oil. The second test at 8,394-8,409 ft. got 270 ft. of oil and 80 ft. of mud-cut oil. Well is drilling ahead.

SOUTHEAST NEW MEXICO

Siluro-Devonian Hit Indicated in Lea

A Lea County wildcat is assured Siluro-Devonian production. It is Lone Star Producing Co. 1 Santa Fe, 30-9s-37e. The well flowed 270 bbl. of oil in 12 hours on 11/64-in. choke from perforations at 12,173-83 ft. Potential is now being made.

APPALACHIAN

OHIO

An east extension to the pool at New Guilford on the 1 Arla Johns, Section 4, Perry Township, Coshocton County, was good for 250 bbl. in a 24-hour test after fracture. The Clinton was logged at 3,265-3,315 ft. with 200 ft. of oil in 11 hours natural.

- In the northeast part of Butler Township, Knox County, C. A. Davis offset an old gasser and found 600,000 cu. ft. gas and 500 ft. oil natural in the 2 Muskingum Watershed. After fracturing the Clinton, 2,810-65 ft., the producer gaged 90 bbl. in 24 hours.
- Two wells completed by East Ohio Gas responded well to fracture. The 1 Mike Racin, Section 36, Chippewa Township, Wayne County, gaged 150,000 cu. ft. natural and 3,400,000 cu. ft. after treatment. The 1 A. & J. Crowe, Section 23, Lawrence Town-

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ship, Stark County, gaged 20,000 cu. ft. natural and 710,000 cu. ft. after treatment.

WEST VIRGINIA

In Licking district, Tucker County, West Virginia, Hope Natural Gas Co. 10012 T. A. Loughrey, wildcat, elevation 1,714 ft., was successful, gaging 1,107,000 cu. ft. gas after second fracture, chert 3,902-4,086 ft., gas 3,920-46 ft., Oriskany sand 4,086 ft., gas 4,150-59 ft., total depth 4,325 ft.

● Plymouth district, Mercer County, Bluefield Gas Co. 1-100 Dee & Lola Bailey, elevation 2,513 ft., tested 26,000 cu. ft. gas after shot, Maxon sand 1,680-1,820 ft., and 2,006-36 ft., gas 1,698-1,700 ft., sand 1,716-37 ft., total depth 2,036 ft.

EASTERN KENTUCKY

Relatively little drilled Perry County recorded a small well recently as Kentucky West Virginia 6347 Harvey Owens was completed for 65,000 cu. ft. of gas daily after shot. Producing zone is the Devonian shale 2,697 ft. to 3,125 ft. total depth. Well was located on Caney Creek.

ARK-LA-TEX

EAST TEXAS

Harrison Gets New Pettet Discovery

A Crane section of the Pettet discovery made 340 bbl. of oil per day on 14/64-in. choke in Harrison County last week. The discovery well is Bill R. Tipton 1 John White, M. V. Lout Survey, 6 miles northwest of Marshall. Production is from perforations at 6,957-66 ft. The new field will be called Northwest Marshall. Closest production is 4 miles east at Woodlawn field.

Smackover Flow Reported In Navarro County Test

The Texas Co. had prospects of a Smackover discovery 2½ miles north of Navarro, in Navarro County, at its 1 Edens, James Smith Survey, A-726.

Top of the Smackover was 8,702½ ft. A 13-minute drill-stem test started flowing gas and distillate, with no estimate on the volumes, under surface pressure of 600 psi. Operators were coring ahead below 8,755 ft.

Location is approximately 6 miles southeast of Corsicana and 30 miles north of nearest Smackover production at Mexia in Limestone County. Nearby

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Powell field oil is in the Woodbine around 3,000 ft.

ARKANSAS

Carter Oil Co. has started operations on its second well at Moreland, 10 miles north of Atkins, Pope County. The new test is on the Homer Eakin farm, 1 mile east of a heavy gas producer that the company brought in September 2, 1956. The first well is estimated to have a 25-million feet capacity.

The newest well is the sixth drilled in the Moreland vicinity. Murphy Oil Co. has drilled four wells. Two of them have proved to be gas producers. They are estimated to be 9 and 11-million feet producers. Thus, with the Carter well, the three in the area will yield 45 million feet of gas.

The three successful wells have been capped while negotiations are being made for their utilization.

GREAT LAKES

MICHIGAN

Oceana County became Michigan's hottest and most significant area during the first week of 1957 as two potential Traverse oil discovery wells appeared to be almost assured.

Newest possible discovery was McClure Oil Co. and C. F. Clapsaddle 1 State-Crystal, SE SE SW 7-16n-16w, Crystal Township, just over 4 miles east of the Pentwater Traverse-Dundee oil pool, and about 10 miles northwest of the other new Traverse discovery, Ford Oil Co. 1 Williams-Richmond, SE SE NE 34-16n-15w, Colfax Township.

The Crystal Township wildcat logged Traverse lime at 1,708 ft. and pay at 1,708-10 ft., present total depth. Well swabbed an average of 10 bbl. of oil a day natural. It was being acidized with up to 500 gallons. Hole carried 1,000 ft. of free oil, no water, natural in 68 hours. Other fill-up tests, after well had been swabbed dry, showed from 350 to 400 ft. of 42.5°-gravity sweet crude oil in from 18 to 21 hours. Major acreage owners around this wildcat, all of whom contributed to the drilling of this significant wildcat, include: Socony-Mobile Oil Co., Inc; Superior Oil Co.; Sun Oil Co.; and McClure and Clapsaddle.

● Meanwhile, Ford Oil Co. 1 Williams-Richmond, new Colfax Township discovery that flowed from 50 to 100 bbl. an hour natural before casing was run, flowed at the rate of 40 bbl. of oil an hour first 3 hours on test after a 300-gal. acid treatment. Both flow rate and pressures increased by the hour during this first test. Well was deepened from 2,035 ft. to 2,040 ft. after long string of 7-in. casing was set at 2,025 ft. Top of Traverse lime was logged at 2,026 ft. Pay showed from 2,032 ft. to present depth. Production will be restricted to about 50 bbl. a day. During first 8 hours well was reported to have flowed approximately 340 bbl. with choke being pinched back hourly. Socony-Mobile was moving tools to the 1 Packard, NW SW NW 35-16n-15w, diagonal northeast 20-acre offset to discovery for first follow-up test in the Colfax area.

PACIFIC COAST

CALIFORNIA

Union Completes First Bardsdale Offset

Union Oil Co. of California has completed the first offset to its recent Pliocene pool discovery on the west edge of the old Bardsdale field in Ven-

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tura County. The offset, 2 Irwin Beryl-wood, located just 30 ft. southwest of the discovery in NE NW 12-3n-20w, was completed flowing at the rate of 775 bbl. daily from three intervals at 4,675-4,975, 5,175-5,320 and 7,820-8,498 ft. Like the discovery, this well is completed below the Oakridge fault in a formation younger than formations producing farther up the hole. The bulk of production at Bardsdale is from Eocene production found on top the steeply overturned fault.

Lloyd Suspends Deep Test

Lloyd Corp. has suspended operations on 802 Lloyd Corp., the second deepest test drilled in the Ventura Avenue field, Ventura County. Lloyd took this test to 16,336 ft. for a look at the Miocene below the D-8 zone but apparently didn't find anything attractive. The D-8 is the deepest producing zone in the field.

Richfield Reports Two Wheeler Ridge Tests

Richfield Oil Corp. reported excellent tests on a pair of wells in the Wheeler Ridge field, Kern County. On one, 65-28 ROK-KCL, a flow rate of 2,026 bbl. daily of 34.6°-gravity crude was reported on a 3 hour gage of the Eocene interval at 10,468-10,758 ft. On the other well, 183-28 ROK-KCL, a 3¾ hour gage resulted in a flow rate of 1,110 bbl. dail yof 37.4°-gravity crude from 8,535-8,738 ft. Both wells are located in the northeast section of 28-11n-20w.

WESTERN CANADA

ALBERTA

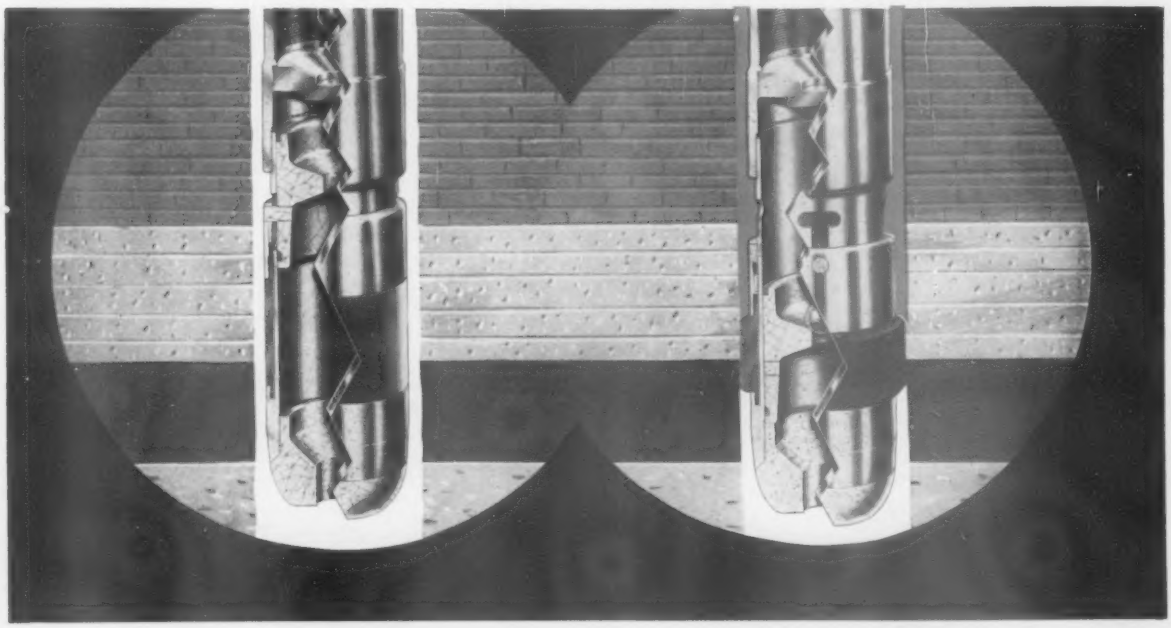
Dual Gas Discovery at Bawlf

A Denver based firm, Williamson Drilling Co., has indicated commercial gas production in two zones at its second exploratory hole in Canada according to information received from that firm recently. The new indicated discovery lies in the Bawlf area of central Alberta on acreage farmed out to Williamson by Imperial Oil, Ltd., and Hudson's Bay Oil & Gas Co., Ltd. Success was assured during drill-stem test operations in the Viking sand when a flow rate of 3,550,000 cu. ft. daily was encountered and in the Glauconitic sand where a maximum flow rate of 3,170,000 cu. ft. per day was established.

The well, Williamson Drilling-H.B. 13-26 Bawlf, on LSD 13, 26-46-18w4, lies 6 miles north of Bawlf townsite, 2¾ miles west of the Phillips 1 Nielsen, D1 gas discovery well and the same approximate distance northwest of the Ponder 15-19 Bawlf exploratory dry hole. The hole is being deepened at the present time and will be taken down as a test of the D2 formation to an approximate completion depth of 3,900 ft.

● The team of Home Oil Co., Ltd., and United Oils, Ltd., has discovered gas in the basal Blairmore formation at its wildcat venture in the Virginia Hills area of northwest Alberta. This strike was chalked up at the Home-Union-Hudson's Bay 9-20 Virginia Hills test, situated 115 miles northwest of Edmonton and that same approximate distance east-southeast of Grande Prairie townsite.

The important find, located on LSD 9, 20-65-12w5, flowed gas at maximum daily rate of 5.1 million cubic feet and gave up 130 ft. of mud and gassy dark brown oil, 120 of very slightly gas-cut mud, and a possible salt water spray at the end of test. Crew was bottomed in the Banff formation when the straddle packer test was conducted around the 5,650-ft.



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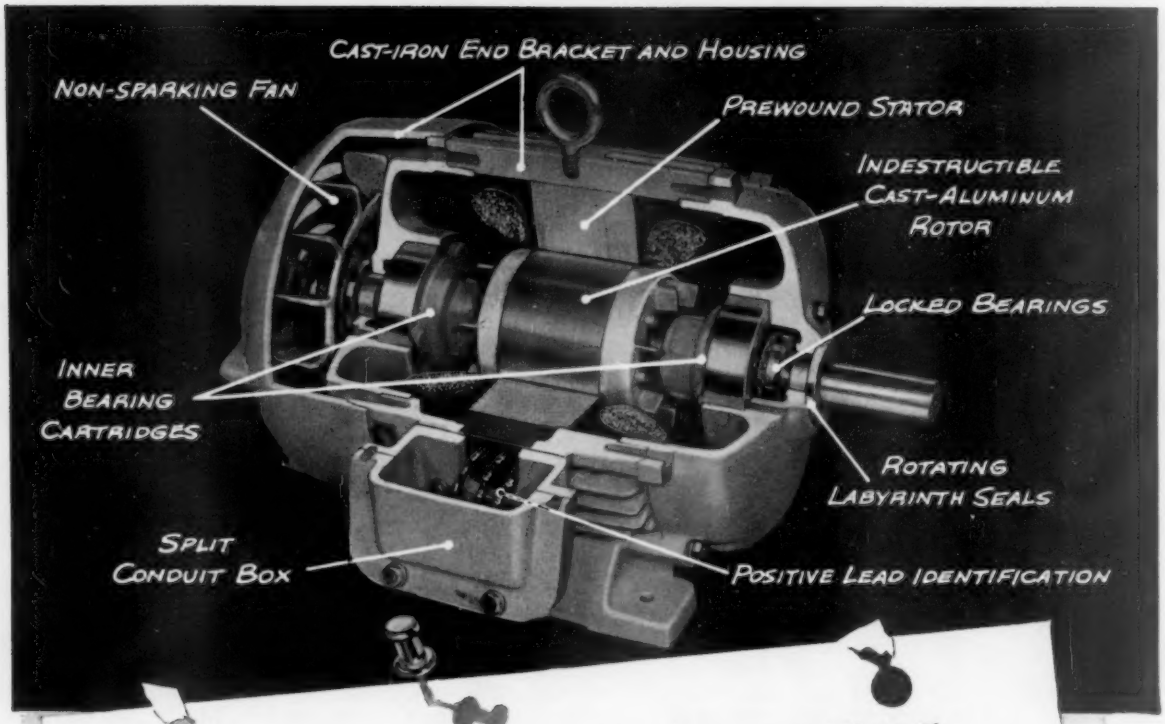

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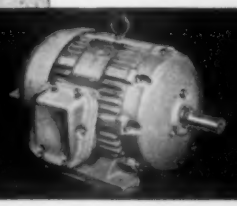
There are many other features such as a new diagonally split conduit box, sturdy cast-iron construction, positive lead identification, non-sparking fan. Our new bulletin No. 1700 shows why you get extra value for your dollar in a Louis Allis explosion-proof motor. Write for your copy.



New LA line explosion-proof motors are available in rerated frame sizes 182 through 326U, and in ratings of 1 to 30 hp, 3 phase, and 1 to 5 hp, single phase. Also available with Underwriters' approval for Class I, Group C hazardous locations.

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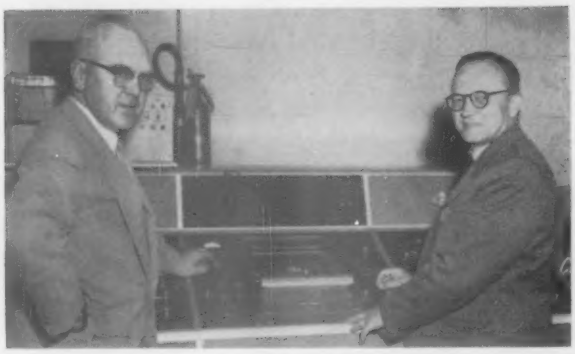
. . . Poland, 1934

DR. L. M. WYROBECK, far left, supervising a crew moving seismic equipment through a deep snow. He was then in charge of field work for Seismograph Service Corp.'s first foreign client in Poland.



. . . London, 1957

DR. WYROBECK, right, is now with British Petroleum Co., London, England. Here he is shown inspecting a seismic replay console. Dr. James E. Hawkins, vice president of Seismograph Service, explains the operation of the magnetic unit during Dr. Wyrobeck's recent visit to Tulsa.

level and operations are again under way which will take the well down to test the pre-Cambrian formation below 10,000 ft.

● Richfield Oil Corp. of California has suspended operations at a discovery well in the southern portion of Alberta after indicating commercial success at the hole during initial production tests run at it. Discovery at this test was indicated when drill-stem test in the Mississippian horizon gave up a gas blow measured at 5,000,000 cu. ft. daily and a recovery of 400 ft. of light-gravity oil.

The well, Richfield-Medallion 6-16 Mazeppa, on LSD 6, 16-19-27w4, was carried to total depth, 8,506 ft. into the D1 zone of the Devonian, and production casing was set to bottom. For production tests, the section 6,784-94 ft. was perforated. Flow tests, run prior to Christmas, through a restricted choke, indicated a gas flow of nearly 2,000,000 cu. ft. daily and a daily recovery of 36 bbl. of oil.

● Colorado Oil & Gas, Ltd., operator of an exploration and development program in the Normadville area of northwestern Alberta, reported that a pair of wells in the project have been completed as oil wells in the D1 formation. These new producers, which are the first to be placed on production from this particular zone of the Devonian in the region, are north and east offsets to the 1 Normandville D3 zone of Devonian oil discovery well which sparked the recent program.

One of the tests, Colorado-Okalta and associates 4-15 Normandville, on LSD 4, 15-79-22w5, was drilled to total depth of 6,805 ft. and production casing was set to 6,670 ft. During production tests the well gave up approximately 200 bbl. of oil daily from the D1.

Meanwhile, the other well in the area to be completed from this horizon, Colorado-Okalta and associates 8-16, Normandville, was drilled on LSD 8, 16-79-22w5. Total depth of this venture was 6,815 ft. and it also indicated a potential of 200 bbl. of clean oil daily.

ROCKY MOUNTAIN

NORTH DAKOTA

Burke County Discovery Goes on Pump

Texota Oil Co. continues tests at its 1 Sorum Nesson-Mississippian in C SE SE 23-163n-91w, Burke County. Pump recovery in 14 hours at the well was 138 bbl. of oil.

Location of this discovery is 2 miles northwest of Flaxton and about 13 miles east of Columbus field. Perforations are at 5,846-56 ft.

SOUTHEAST COLORADO

Oil Swabbed at Bent County Well

Bent County on the Las Animas arch has another oil discovery. This one belongs to Continental Oil Co. It is the 1 Lynn in C SE NW 13-20s-49w.

The well was originally put down by D. D. Harrington and completed in the Morrow - Pennsylvanian sand at 4,834-46 ft. for 3,430 M.c.f. of gas per day. The workover taken on by Continental is now a Marmaton-Pennsylvanian oil producer at 4,232-54 ft.

COLORADO

Washington County Well Testing on Pump

Curlass Oil and Calvert Drilling Co. are testing the 1 Stoner on pump in C NW SE 32-3n-53w, Washington County, Denver basin wildcat.

Recovery on a drill-stem test was 500 ft. of oil and 125 ft. of water in the D sand. This indicated discovery is 2 miles west of Pleasant Valley, separated by two dry holes from nearest production.

Lyons-Permian Well Completed in Weld

A new Lyons sand (Permian) oil pool has been opened in the Denver basin. The California Co. is the discoverer. The 1 Brunner, C SW SW 26-7n-67w, Weld County, was completed on the pump for 79 bbl. of oil per day. Perforations are at 8,976-82 and 9,005-10 ft.

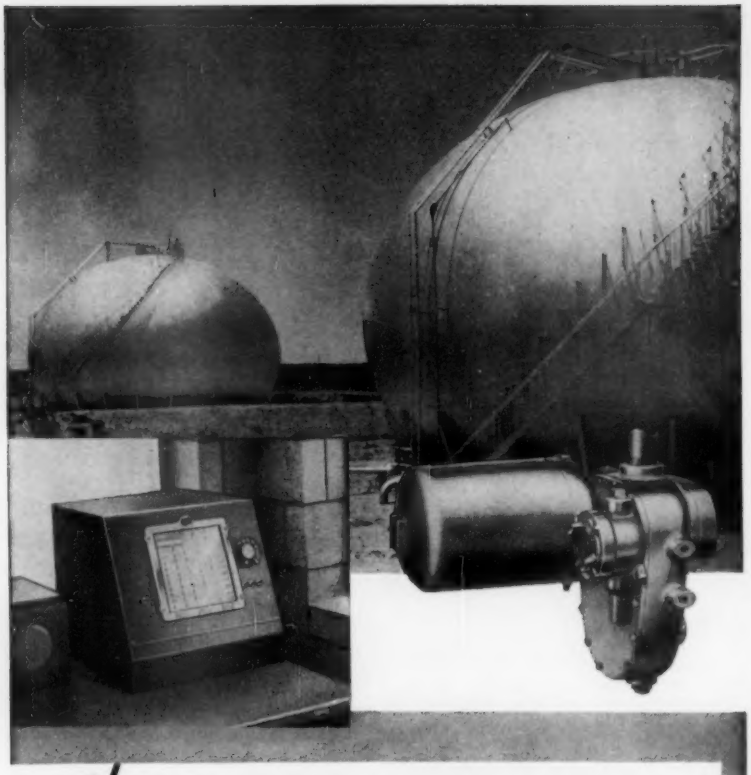
A confirmation well, the 2 Brunner, is idle for repairs. Total depth here is 8,400 ft.

Another pre-Cretaceous wildcat is under way in the Denver basin, 2 miles southwest of Loveland, Colorado. Shell Oil Co. 1 Kirkpatrick, SW SW NE 28-5n-69w, Larimer County, is drilling at 1,357 ft.

UTAH

Paradox Test Due In Blanding Area

A Paradox wildcat has been staked in San Juan County, 8½ miles southeast of Blanding. Gulf Oil Corp. will



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take the 1 Gulf-Aztec-Montezuma-Federal down to about 6,500 ft.

The wildcat, located in C NE NW 25-37s-23e, is about 16 miles north of Aneth field production. There has been no drilling in the immediate 5-mile area.

Indian Discovery Finaled in San Juan

Gulf Oil Corp. has completed the 1 Desert Creek-Indian discovery in C NE NE 1-41s-22e, San Juan County, Paradox basin.

The well gaged 263 bbl. of oil daily on 12/64-in. choke from perforations at 5,800-10 ft. in the Paradox(?). This discovery is 3½ miles southwest of Creek field. It is the westernmost production in the Aneth trend of southeastern Utah.

Unitah County Gas Discovery Shut in

El Paso Natural Gas Co. has a new gas discovery in Uintah County at its 3 Unit, NE NE SE 15-10s-23e. The well gaged 1,790 M.c.f. of gas per day from perforations in the Mesaverde at 6,748-6,823 ft. Top of the Mesaverde is at 5,873 ft.

The discovery is shut in. It is southeast of the 2 Unit, separated by a dry hole. The 2 Unit well, NW NE NE 11-10s-23e, flowed 1,350 M.c.f. of gas per day last spring. Production here was from the Wasatch at 4,663-70 and 4,850-88 ft.

MONTANA

Amerada Below 4,528 Ft. At Outlook Confirmation

The confirmation well to the recent prolific Silurian discovery at Outlook is drilling below 4,528 ft. Amerada Petroleum Corp. 1 Loucks, C NE SW 35-36n-52e, 4 miles southwest of the 1 Tange discovery, one of 1956's exploratory highlights, will be closely watched in the next few weeks. The 1 Tange discovery flowed 2,742 bbl. of oil per day on ½-in. choke. A later test on ⅛-in. choke made 105 bbl. of oil in 10 hours. The discovery well is now shut in.

Oil Flow Reported At Cabin Creek Well

The second well to get oil from the Mission Canyon-Mississippian at Cabin Creek field in Fallon County, eastern Montana, is Shell Oil Co. M21-33 Unit, C NE NW 33-10n-58e.

The well flowed oil at the rate of 25 bbl. per hour on ¼-in. choke. Per-

forations are at 7,330-50 ft. There were 6 bbl. of water per hour, also, with the oil flow.

The first well in this field to produce from Mississippian was completed several weeks ago. The Shell well finaled for 305 bbl. of oil and 37 bbl. of water per day. Perforations were at 7,298-7,324 ft. at that new-pay discovery for the field.

Production at Cabin Creek, located on the Cedar Creek anticline, prominent Williston basin edge structure, was from the Ordovician and Silurian rocks.

WESTERN NEBRASKA

Kimball Wildcat Recovers Oil On "J" Sand Test

A "J" sand test at 6,374-85 ft. got 2,070 ft. of free oil at Mountain Valley Oil Co. 1 Enyart, C NE NE 4-13n-55w, Kimball County. The indicated discovery is ½ mile from Dietz field, separated by two dry holes from the field. Pipe is being run.

Operator Runs Pipe at Banner County Strike

Miracle-Fifer Drilling Co. ran pipe to 6,210 ft. at its 1 Snyder in NE NE NE 27-18n-55w, Banner County discovery, 1½ miles southeast of Lovercheck field.

A drill-stem test in the "J" sand at 6,140 ft. recovered 1,560 ft. of oil, 60 ft. of mud-cut oil and 270 ft. of water.

Banner County Discovery Completed By Shell

Shell Oil Co. completed a new discovery well in Banner County. The 1 Darnell, C NE SW 30-19n-53w, pumped 202 bbl. of oil per day.

Production is from perforations at 5,153-72 ft. in the "J" Dakota sand. This is the company's third new pool-opener in this area in the past few months. Location is 1½ miles southwest of Mosier field.

WYOMING

Gas Tested at East LaBarge

Gas was recovered on drill-stem tests at 7,170 and 7,590 ft. at John L. Kemmerer 2-A Government, NE NE NW 33-27n-112w, East LaBarge area of Sublette County.

The well flowed gas at the rate of 439 M.c.f. per day. Other tests, four in all, flowed 298 M.c.f., 406 M.c.f., and 214 M.c.f.

Location of the wildcat is 24 miles east of LaBarge field oil production.

Small Hot Springs Discovery Finaled

A small Tensleep discovery was completed by G. L. Reason in Hot Springs County. The 1 Government, C NW NE 26-43n-91w, flowed 25 bbl. of oil and 2,000 bbl. of water per day from perforations at 3,672-3,716 ft.

This new pool-opener is 1 mile north of Black Mountain field, a Tensleep producer, and 2 miles east of Lake Creek field.

SOUTH DAKOTA

Oil Show Reported At Harding Test

Oil was recovered on tests at 8,315-65 ft. at Shell Oil Co.'s 32-27 Government wildcat in C SW NE 27-20n-5e, Harding County. Recovery was 205 ft. of mud and water-cut oil, 40-50 per cent oil.

This prospect is 9 miles south of Buffalo field, one of South Dakota's two producing fields.

Successful Wildcats

TEXAS GULF COAST

Hardin County: Atlantic Refining Co. 1 H&TC fee, H&TC Sur. 220, A-810. IP 76.1 BOPD, ⅛-in., 38.5°, perforations 7,142-50 ft. (Yegua Y-6 sand). TD 7,306 ft. (New field.)

W. P. Luse et al 1 Kirkpatrick and Williams, WCRR Sur. 353, A-525. IP 3,950 M.c.f. daily, ¼-in., perforations 9,477-92 ft. (Cook Mountain). TD 9,635 ft. (New field.)

Sun Oil Co. 1 Williams, Gregoria Garcia Sur., A-22. Shut-in gas well, no gage, perforations 9,587-89 ft. TD 10,012 ft. (New field.)

SOUTHWEST TEXAS

Brooks County: Associated Oil & Gas Co. 5-B Cage, Guadalupe Del Encinal Leonardo Vargas Sur., A-603. IP 10,000 M.c.f. daily, open-flow potential, G L R ratio, 27.6 M.c.f. per bbl. 63.6°, perforations 7,156-66 ft. TD 7,930 ft. (Extension and new pay in Cage Ranch area.)

Hidalgo County: Hargrave Oil Corp. 2 Lutz, Rio Grande Development Co. Subd., Block 32. IP 99.9 BOPD, ¼-in., 52°, perforations 7,220-32 ft. TD 9,000 ft. (New field—Goldring.)

Nueces County: British-American Oil Producing Co. 1 Knolle, De La Garza Montemayor & Sons Sur., A-221. IP 381.15 BOPD, ¼-in., 27.4°, perforations 5,118-22 ft. TD 5,720 ft. (New field.)

Starr County: Dulaney Oil Co. 1 Guerra et al, Survey 11. IPP 33.19 BOPD, 42.3°, perforations 2,710-16 ft. TD 2,947 ft. (Extension and new pay in El Puerto field.)

Webb County: Weaver & Sharp 2 Biel, Sur. 2403. IPP 41.77 BOPD, 22.3°, open hole 993-97 ft. TD 997 ft. (New pay in Biel field.)

LOUISIANA GULF COAST

Terrebonne Parish: Union Oil Co. of California 1 State Lease 2826, Timbalier Bay. IP 160 BOPD, 5/32-in., 35°, perforations 11,938-48 ft. TD 15,010 ft. (New field between Caillou Island and Timbalier Bay fields.)

NORTH TEXAS

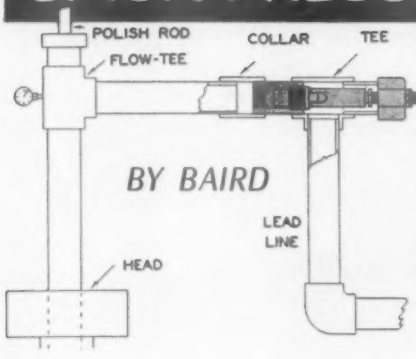
Archer County: W. F. Holmes 1-N Petrex, Blk. 126, ATNCL Subd., 1½ mi. SE Holliday. IPP 108 BOPD, GOR 740, pay 4,102 ft. TD 4,109 ft.

Baylor County: M. J. Frances 1 Smith, 37-45-H&TC, A-226, 3½ mi. SE Bomarton. IPP 19 BOPD, 36°, pay 1,415-20 ft. TD 1,550 ft.

Clay County: Bridwell Oil Co. 1 Kinder,

BACK-PRESSURE REGULATOR

"Wherever there's oil you'll find Baird products on the job."



Keeps pressure on tubing strings.

For wells that head up and flow, back pressure on the tubing tends to keep the tubing full which prevents stuffing box trouble and increases pump efficiency. By maintaining a back pressure on the tubing, this regulator keeps gas from breaking out of the solution and thus helps to prevent paraffin formation.

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Sec. 2, Block 2, Clark & Plumb Subd., 3½ mi. SE Scotland. IPP 46 BOPD, 41°, GOR 380, pay 4,613 ft. TD 4,847 ft.

Knox County: J. L. Stodghill and C. P. Baker 1 Farrington, Sec. 100, Blk. 2, D&W Sur., 3 mi. NE Munday. IPP 42 BOPD, 35°, GOR 200, pay 1,934-44 ft. TD 2,101 ft.

Montague County: E. S. Heyser and Larson & Thomas 1 Baker, J. B. Miller Sur., A-460, 2½ mi. NE Dyemound. IPP 72 BOPD, 39°, GOR 410, conglomerate 6,627-34, 6,636-47 ft. TD 6,974 ft.

Young County: L. T. Burns estate 2 Hightower, TE&L Sur., 190, A-437, 4 mi. W Olney. IP 133 BOPD, 6/64-in., TP 850 psi. 44°, GOR 577, perforated 5,136-39 ft. TD 3,160 ft.

WEST TEXAS

Garza County: Continental Oil Co. 1 Blake "1204," Sec. 1204, I&GN Sur., 6 miles NW Post. IPP 126 BOPD, 34°, GOR 60, San Andres 3,182-3,220, 3,265-82 ft. TD 4,940 ft. Blake field, suggested name.

Irion County: McIntyre Oil Co. 1-A Sugg, 53-14 H&TC, 7 miles NE Barnhart. IP 248 BOPD, 10/64-in., TP 850 psi., GOR 700, 38° Clearfork 4,535-67 ft. TD 4,890 ft.

WEST CENTRAL TEXAS

Parker County: Ben J. Taylor 1 Stevens, Sec. 173, T&P Sur., 8 miles N Weatherford. IP estimated 2,000 M.c.f. gas, TD 5,440 ft.

Stephens County: Ambassador Oil Corp. 1-D West, Sec. 1094, TE&L Sur., 7 miles N Caddo. IP 4,250 M.c.f. gas, TD 4,038 ft.

Throckmorton County: Simpson Hines Oil Co. 1 Huston, Sec. 295, BBB&C Sur., 4½ miles S Throckmorton. IP 528 BOPD, 16/64-in., TP 450 psi., GOR 200, 42°, conglomerate 4,746-48 ft. TD 4,779 ft.

ALBERTA

Merrill Sun C & E 8-16 Cassils, LSD 8, 16-19-15w4. TD 3,635 ft. Bow Island gas well.

Richfield Medallion 6-16 Mazeppa, LSD 6, 16-19-27w4. TD 8,506 ft. Mississippian gas well (wet).

SASKATCHEWAN

Imperial 16-27A Carievale, LSD 16, 27-2-31w1. TD 3,900 ft. Mission Canyon oil well.

NEW MEXICO

Sandoval County: S. D. Johnson 1 Chapman, C SE SW 20-23n-6w. IP 40-60 BOPD, Gallup sand discovery, new field. TD 5,703 ft.

WYOMING

Hot Springs County: G. L. Reasor 1 Government, C NW NE 26-43n-91w. IPP 25 BOPD, 2,000 BWPD, Tensleep discovery, new field. TD 3,767 ft. Tensleep.

COLORADO

Weld County: The California Co. 1 Brunner, C SW SW 26-7n-67w. IPP 79 BOPD, Lyons-Permian discovery, new field. TD 9,048 ft. Satanka.

KANSAS

Barton County: Bailey pool was opened at Thunderbird Drilling Co. 1 Bailey, NW NE SW 30-18s-11w. Completing in Arbuckle. TD 3,417 ft.

Clark County: East Snake Creek pool was opened at Pure Oil Co. 1 Harper "D," C SE NE 24-34s-21w. Completing in Morrow. TD 5,612 ft.

Edwards County: South Trousdale pool was opened at Sunray Mid-Continent Oil Co. 1 King, NE NE SW 33-26s-16w. IP 5,304 M.c.f. of gas per day, Cherokee-Pennsylvanian. TD 4,876 ft.

Ellis County: South Riverview pool was opened at Cooperative Refinery Association, et al., 1 Johnson "Z," SE SW SW 32-11s-18w. Completing in Lansing. TD 3,639 ft.

Finney County: Northwest Pleasant Prairie pool was opened at Helmerich & Payne 1-30 USA, NE NE SW 30-26s-34w. Completing in Mississippian. TD 5,278 ft.

Marion County: Doyle Creek pool was opened at Anderson-Prichard 2 Kent, SW NE SW 31-21s-3e. IP 11 BOPD, Hunton. TD 2,915 ft.

Rush County: Lohrey pool was opened at Aylward Drilling Co. 1 Lohrey, SW SW SW 35-17s-17w. IP 6,700 M.c.f. of gas per day, conglomerate. TD 3,605 ft.

Russell County: Kune pool was opened at A. F. Schmitt 1 McKune, NE SE SW 17-13s-15w. Completing in Lansing. TD 3,275 ft.

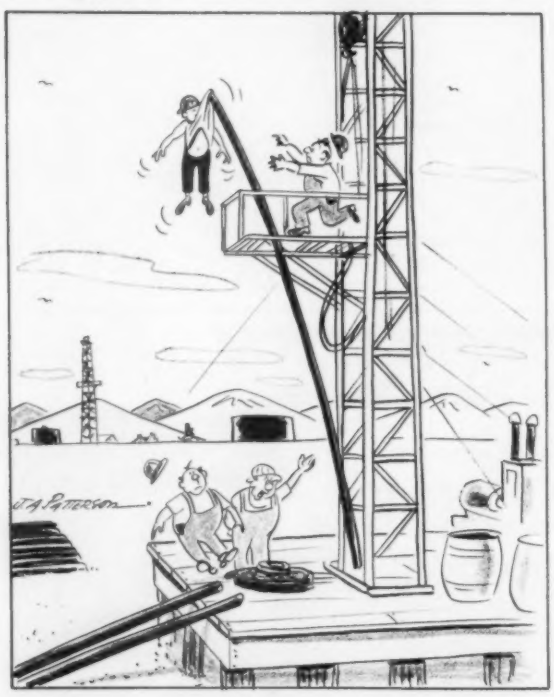
Stevens County: Panoma pool was opened at Hugoton Producing Co. 2-12 Panoma, NE NW SE 12-31s-38w. IP 16,124 M.c.f. of gas per day, Council Grove-Permian. TD 7,617 ft.

Woodson County: Annabelle pool was opened at Thunderbird Petroleum Co. 1 Corkery, SW NE NE 32-25s-15w. IPP 25 BOPD, Squirrel sand. TD 1,190 ft.

NORTH LOUISIANA

Catahoula Parish: H. L. Rowley, Inc. 1 Renfrow, NEc NE NW 24-8n-6e. IPF 100 BOPD, Wilcox 4,471-72 ft. TD 5,710 ft. Opens Patton Church field.

Bossier Parish: Rock Oil Co. 1 J. A. De Guerce, 13-16n-12w. OWWO. IP 1,750 M.c.f. of gas per day, Hosston 5,850-57 ft. TD 6,137 ft. New pay in Elm Grove pool.



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ALL-NEW D&S TRI-DIA BIT!

faster penetration, more rig savings

Designed for safety

Reduced O D wall contact approaches that of Tri-Cone Rock Bit.

Eliminates swabbing, hydraulic action when making trip.

Permits washing out large junk iron pieces, minimizing that hazard.

Readily washes out cavings to bottom.

Reduces mud wall cake sticking hazard.

Largest measurable diameter materially less than diameter of hole it will cut. (Special Bit Breaker required.)

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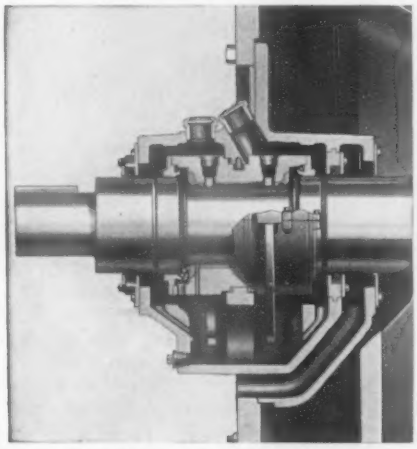
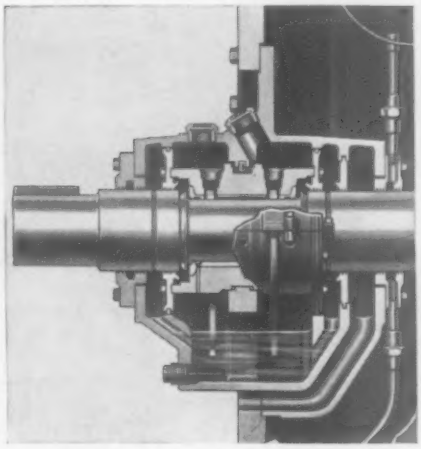
NEW Bearing Design Means Better Motor Performance

Allis-Chalmers capsule-type sleeve bearings now perfected for complete motor line



Standard capsule-type sleeve bearing



High speed capsule-type sleeve bearing

A new feature—an improved capsule-type bearing design—has been added to the Allis-Chalmers complete line of large end-shield bearing motors. This new bearing will give you better motor service, simplified maintenance and longer motor life through features like:

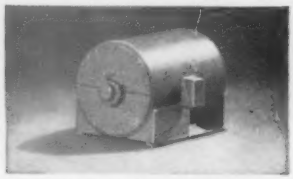
- Dust-tight, leakproof enclosure protects bearing from dirt, dust or abrasive materials.
- Venting system prevents oil leakage — keeps oil and vapor from getting into motor enclosure.
- Dual oil-rings insure bearing surface lubrication — either ring can adequately lubricate bearing.
- Split end-shield gives easy accessibility to winding and air gap — without disturbing capsule or bearing alignment.

Drip-proof or splash-proof cage motor

Synchronous or wound-rotor motor

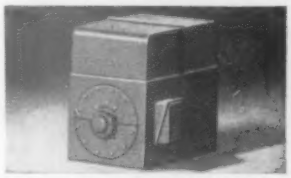
High speed cage motor

Weather-protected motor



Totally-enclosed fan-cooled motor

Totally-enclosed forced-ventilated motor



Water-cooled or inert-gas-filled motor

Capsule-type bearings are standard on these Allis-Chalmers motors.

You get **MORE** from Allis-Chalmers motors

More design and construction features — more application help. For complete information, contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

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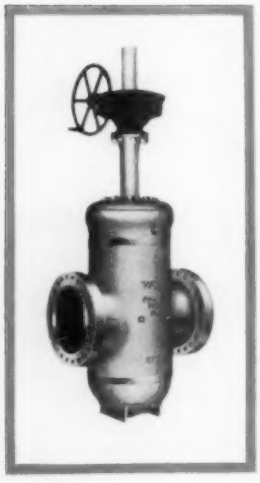
W-K-M Valves—

have all the features* essential for safe, successful hot tapping



* Through-conduit assures a free, unobstructed passageway for tapping bit.
* Parallel expanding gates provide positive upstream and downstream seal.
* Completely protected, seats cannot be damaged during tapping operation.
* When tapping machine is removed and valve is closed and opened, the shavings are dumped directly into the line . . . cannot interfere with valve operation.

When tap is completed—and bit removed—your new take-off line will have the industry's finest pipeline valve, ready to give you years of dependable service. Talk to your W-K-M representative about the money-saving performance and versatility of W-K-M Pipeline Valves. W-K-M Division of ACF Industries, Incorporated. Plant: Missouri City, Texas, Mailing Address: P. O. Box 2117, Houston, Texas.

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W-K-M

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In Austin, it's apparent . . .

. . . Pitzer's Work Bears Fruit

IN mid-December a large delegation of independent producers descended upon Austin to urge the Texas Railroad Commission to forego hiking the Texas allowable until producer hardships over a wide area of West, West Central, and North Texas were eased.

Holding Texas oil output to a low level, they felt, would force major company buyers to stop pipeline proration in spotted areas and to connect their gathering systems to wells long without pipeline outlets.

The independents came well armed with supporting figures and case histories. These showed almost 8,000 unconnected wells and numerous cases of proration by pipeline and even truck transporters.

In the vanguard of the delegation were several members of the West Central Texas Oil and Gas Association. In this association's West - West Central Texas bailiwick are more than 5,000 of the unconnected wells.

The prime-mover of the group was a former association president, P. W. (Bill) Pitzer, Jr.

P. W. (BILL) PITZER

. . . the Railroad Commission hears his story.

Association work . . . Pitzer, now 41, is a Breckenridge, Tex., operator and drilling contractor. He was president of the group 2 years before retiring in favor of E. Bruce Street, of Graham, Tex., last October.

He is a big, impressive-looking man. Pitzer also is amiable and soft-spoken but a hard, determined worker. His prime aim as association president was to find new markets for unwanted oil in the association's 35-county area.

Under his direction, the association battled in Washington to cut imports and investigated the possibilities of organizing area producers to supply oil for a pipeline to the West Coast and for a big crude - sweetening plant to make the sour oil more acceptable to major company buyers.

During his term, too, the association began its drive to collect accurate statistics on unconnected wells, pipeline proration, and on how these things were depressing development of new reserves. Cost figures were gathered showing the losses area operators were sustaining in having to truck their oil.

The statistics are being used effectively by independents in Austin now.

Early life, career . . . Pitzer has called West Texas "home" all his life. He was born in Abilene May 6, 1916. The family moved to Breckenridge in 1919 and settled there permanently. Young Pitzer's father, P. W. Pitzer, Sr., was a well-known oil man operating as a partner in Pitzer & West.

In 1933, while young Bill was still a senior in high school, the two partners organized Chemical Process Co. at Breckenridge. Bill was given a piece of the company after receiving his B.S. degree in petroleum engineering from the University of Texas in 1938. The same year, he married Nancy Darden, of Waco, Tex., and moved to Midland for Chemical Process. He stayed at Midland for 2 years before moving back to Breckenridge.

Pitzer entered the service in 1942 and emerged in December 1945 as a first lieutenant in the Air Force.

While he was still in the service, the Pitzers sold out their interest in Chemical Process to Independent Torpedo Co. of Breckenridge. Young Pitzer, on his return, plunged into the oil business on his own as an independent operator.

Since then he has built up substantial production. One of his most important deals was the purchase of 26 Mississippian, Caddo, and Strawn wells in Throckmorton and Stephens counties from James H. Snowden et al about 1½ years ago.

His contracting firm, Pico Drilling Co., now has two rigs rated at 6,500 and 4,500 ft., which are kept active in the West Central Texas area.

He has been active in oil associations other than his home group, serving as vice president of the Texas Mid-Continent Oil and Gas Association and as a director of the Independent Petroleum Association of America.

The Pitzers have four children: Susan, 13; P. W. Pitzer, III (nicknamed Trey); Pamela, 6; and Barbara, 3.

J. W. DeFore, plant foreman for The Texas Co. at Snyder, Tex., has been promoted to supervisor of gasoline plants and transferred to Fort Worth.

R. V. Towner, vice president and treasurer of Brown Drilling Co., has been elected president. He succeeds **E. C. Brown,** who has been named chairman of the board and will continue as chief executive officer of the company.

A. A. Glodt, Gulf Oil Corp., has been named chairman of the offshore operators committee in New Orleans. He succeeds **H. E. Denzler, Jr.,** The California Co. **B. D. McCampbell,** Kerr-McGee Oil Industries, Inc., has been elected secretary, replacing **J. B. Harrison,** Atlantic Refining Co.

Paul Schultz, Tulsa, president of Blackwell Oil & Gas Co., has been elected president of the Oklahoma Independent Petroleum Association. He succeeds **Roy G. Woods.** Other officers are **Erritt Dunlap,** vice president, Ardmore, Okla., independent; and **Carl Anderson, Jr.,** secretary-treasurer, vice president, An-Son Petroleum Co.

E. D. ACKERMAN

E. Dumont Ackerman, acting general manager of International Petroleum (Colombia), Ltd., in Bogota, Colombia, has been transferred to International Petroleum Co.'s executive office in Coral Gables, Fla., as exploration coordinator. Ackerman became exploration manager of International (Colombia) in 1951. He had previously been with Creole Petroleum Corp. in Venezuela. With Creole, Ackerman served as district geologist in the Temblador, Quiriquire, and Jusepin districts, assistant division geologist of the western division, and eastern division geologist.

C. L. Wallace, formerly superintendent of Ohio Oil Co.'s Lovell, Wyo., refinery, has been transferred to the company's Robinson, Ill., refinery as coordinator of maintenance work. Wallace has been with Ohio since 1930.

Personals

John M. Houchin, chairman of the operating committee of Phillips Petroleum Co., has been elected vice president of the company. Houchin has been with Phillips since 1933. He was general superintendent of production before becoming chairman of the operating committee last year. **Harry G. Fair,** vice chairman of the operating committee, will succeed Houchin as chairman. He has been with the company since 1939. **W. C. Hewitt,** assistant general manager of Phillips Chemical Co. and formerly superintendent of operations for the subsidiary, will succeed Fair as vice chairman of the operating committee. **Harry D. Brookby,** manager of the southwest region land and geological department, has been appointed manager of the foreign department. Brookby joined Phillips as a geologist in 1938.

J. M. HOUCHIN

H. G. FAIR

H. D. BROOKBY

W. C. HEWITT

H. M. Romig, retired chief engineer for process engineering design in the Whiting, Ind., general engineering department of Standard Oil Co. (Ind.), has joined Neches Butane Products Co. in Port Neches, Tex., as project manager of butadiene plant expansion. Romig retired from Standard several months ago.

Glascott Dawsongrove, development engineer for Shell Oil Co., has been transferred to the Los Angeles area office from Ventura, Calif. **Robert F. Phelan,** mechanical engineer at Ventura, has been named production engineer there, and **Thomas R. Schmidt,** mechanical engineer at Ventura, has been transferred to Shell Development Co. in Emeryville, Calif.

J. Frank Cox, production foreman for Stanolind Oil & Gas Co. at Pine Island, La., has been transferred to Duncan, Okla., as area field superintendent.

Raymond E. Fairchild, formerly district geologist in Houston for Pan American Production Co., has joined Trunkline Gas Co. as Houston district geologist. Fairchild is a graduate of Ohio University and the University of Missouri.

W. L. Kistler, Jr., Tulsa independent operator, has been named a director of the National Bank of Tulsa. He replaces **P. H. Bohart,** vice president of Gulf Oil Corp., who was transferred to Pittsburgh from Tulsa last spring.

Sir Francis Hopwood, managing director of Shell Petroleum Co., London, and a principal director of Bataafsche Petroleum Mij., The Hague, will retire June 30 in a move that will move two other executives of Royal Dutch-Shell companies up the ladder. The retiring head of the top English operating company in the group will be succeeded by **H. Wilkinson,** who now heads Canadian Shell, Ltd., at Toronto. Wilkinson in turn will be succeeded by **Ian Davidson,** who is now president of Cia. Shell de Venezuela, the group's largest single producing company. **G. C. K. Dunsterville,** a vice president of C.S.V. since 1953, will be the new president of the Venezuelan Shell company. Sir Francis Hopwood will remain a managing director of Shell Transport & Trading Co., Ltd., and a director of Shell Petroleum Co., Ltd. Wilkinson has been on the board of Shell Transport & Trading since 1948, on the board of Shell Petroleum since 1953, and on the board of N.V. de Bataafsche Petroleum Mij. since 1954.

HOLLOWAY

Fred A. L. Holloway, general manager of Esso Standard Oil Co.'s East Coast division, manufacturing department, has been appointed assistant general manager of manufacturing in New York. **Ross Murrell,** general superintendent of the company's Bayway refinery, Linden, N. J., has been appointed to the new position of manager. **Dave F. Edwards,** general superintendent of the Bayonne, N. J., refinery, becomes manager there. The changes are the result of a plan to decentralize refining operations. No new East Coast division general manager will be appointed.

E. B. WASSON

Edward B. Wasson, division geologist in Denver for Cosden Petroleum Corp., has been promoted to manager of the Rocky Mountain division. He succeeds **J. S. Cosden, Jr.,** who has resigned to join American Petrofina, Inc., as assistant to the president. **Robert R. Berg,** Casper, Wyo., will replace Wasson as Denver division geologist. Wasson was geologist and geophysicist for The California Co. before joining Cosden 2 years ago.

C. V. (Red) Dittman, superintendent of General Petroleum Corp.'s Salinas Valley district in the San Ardo, Calif., area, retired January 1 after 36 years of service.

T. J. E. (Ed) Jobin, assistant district superintendent of production and drilling for Phillips Petroleum Co. in Cut Bank, Mont., has joined Rutledge Drilling Co. as chief drilling engineer in Williston, N. D.

Gilbert Millar, process foreman at Pan-Am Southern Corp.'s Destrehan, La., refinery, has joined Wainwright Producers & Refiners, Ltd., Wainwright, Alta., as refinery superintendent and assistant manager.

Karl G. Krech, assistant manager of crude-oil purchases and sales for Atlantic Refining Co., has been promoted to general manager of the department. Krech has been with Atlantic since 1925.

Allan Shivers, who steps down January 15 as governor of Texas, has arranged to buy a half interest in Western Pipe Lines, Inc., an Austin, Tex., pipeline contracting firm. He will join the company January 15 as chairman of the board.

B. J. Schulz, chief process engineer at Magnolia Petroleum Co.'s Beaumont, Tex., refinery, has been transferred to the headquarters staff of the Socony Mobil Oil Co., Inc., laboratories at New York. He will take over there February 1 as coordinator of lubricants and allied products. **R. E. Woodham** has been promoted by Magnolia from assistant chief process engineer to chief process engineer at Beaumont to replace Schulz. **A. B. Hiser** has moved up from supervisory process engineer to assistant chief process engineer. **R. G. Hutton** succeeds Hiser as supervisory process engineer.

Personals

J. S. FREEMAN

John S. Freeman, senior vice president in charge of production for Skelly Oil Co., has been elected president and a director of the company. He succeeds **William G. Skelly,** who founded the company in 1919. Skelly has been elected chairman of the board. Freeman joined Skelly in 1922. He has been vice president in charge of production since 1948 and senior vice president since 1956.

Reid Brazell, president of Leonard Refineries, Inc., Alma, Mich., has been appointed special consultant to the Office of Oil and Gas. Brazell will study the effect of emergency European oil movement on independent refiners.

William M. Holaday, formerly head of research and development for Socony Mobil Oil Co., Inc., is leaving the company February 1 to become deputy assistant secretary of defense (research and development). Holaday has been on leave of absence and acting in this capacity since February 1, 1956.

J. L. HOLLIS

Jack L. Hollis has been promoted by British - American Oil Producing Co. from chief geophysicist to the newly created position of exploration coordinator. **Sherman L. Vencil** and **Walter Speckhard** have been named area geophysicists. Vencil will supervise geophysical operations in Texas, Louisiana, Mississippi, and southern New Mexico. This comprises the company's southern and southwestern divisions. Speckhard, formerly central division geophysicist at Oklahoma City, will direct operations from Dallas in Kansas, Nebraska, Oklahoma, and the Rocky Mountain states. Hollis joined B.A. in 1950 as geophysicist after spending 17 years with Seismograph Service Corp. Vencil worked with Shell Oil Co. and an independent operator prior to joining B.A. in 1952. Speckhard has been with the company since January 1955. He formerly worked with a seismograph company.

Dan Cipriani has been named head of the Oklahoma City development geological division of Phillips Petroleum Co. **Harry Segnar** will head exploration activities in the division.

William J. Abnett, assistant technical adviser for natural-gas and natural-gasoline projects in Sun Oil Co.'s Philadelphia office, has been appointed assistant project engineer in the manufacturing department.

Nugent T. Brasher, Stanolind Oil & Gas Co., has been elected president of the West Texas Geological Society for 1957. Other new officers are: **Harold L. Williams,** vice president; **Glen L. Evans,** secretary; and **Ross H. Ley,** treasurer.

Joe Ratway, geologist with Carter Oil Co. in Miles City, Mont., has joined An-Son Petroleum Corp. as geologist in Oklahoma City.

William F. Oline, junior geologist with Northwest Production Corp. in Albuquerque, N. M., has been promoted to senior geologist and transferred to Rock Springs, Wyo.

DEATHS

Dr. William H. Twenhofel, 81, Orlando, Fla., geological consultant to Magnolia Petroleum Co. and other companies operating in Florida, and long time professor of geology at the University of Wisconsin, died January 4 in Atlanta, Ga. Twenhofel was the author of numerous textbooks on geology. He was chairman of the geology department at Wisconsin from 1940-45, later was a visiting professor at Stanford, Yale, and the University of Tulsa.

Bert C. Stivers, 76, retired vice president of Margay Oil Co., died January 8 in Sapulpa, Okla. He had been retired since 1946.

Dr. Ferdinand W. Breth, 70, vice president and technical director of L. Sonneborn Sons, Inc., died January 8 in New York. He was instrumental in developing porocel, which activates bauxite and is used to treat lube oils and wax.

Memorial services were held January 9 in Dallas for **Anthony Folger,** senior geologist with DeGolyer & MacNaughton, who died in the December 9 crash of an airliner near Vancouver. Wreckage of the plane has not yet been located.

Clarence A. Wiggins, 62, who retired as president of Drilling & Exploration Co., Inc., 2 weeks ago, died January 7 in Houston after a heart attack. Wiggins was president of Adams Oil & Gas Co., Houston, and an independent operator there before becoming president of Drilling & Exploration in 1952.

Adrian Moore, 71, Houston independent, died January 4 in Houston. Moore was district production manager in the Houston area for the Petroleum Administration for War during World War II until his resignation in protest of PAW production division rules.

Frank L. Cochran, 73, general manager of the Chicago office of Standard Oil Co. (Ind.) from 1941 until his retirement in 1948, died recently in Pacific Palisades, Calif. Cochran was manager of Indiana Standard's Indianapolis office from 1937 to 1941 and earlier served as assistant general manager of the Rocky Mountain division.

William Henry Brimm, 77, Midland, Tex., independent operator in the Oklahoma, Kansas, and Louisiana areas, died January 4 in Tulsa after a heart attack. Brimm operated in Tulsa from 1915 until 1943, when he moved to Wichita.

Charles A. C. Johnson, 68, refining and marine engineer with Esso Standard Oil Co. from 1918 to 1952, died January 4 in Clearwater, Fla.

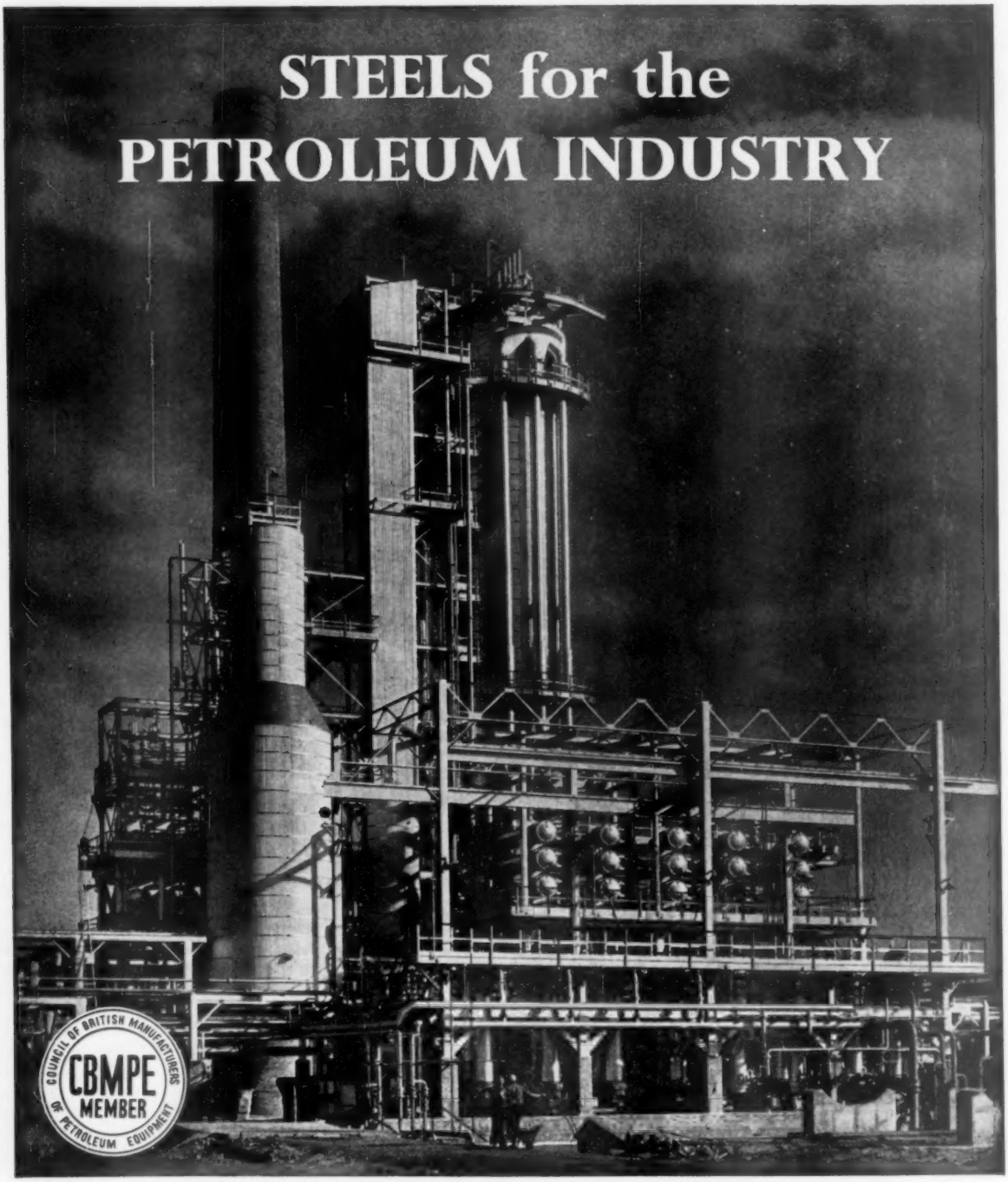
S. W. Andrews, 66, director of Fluor Corp., Ltd., and president of H. G. Acres & Co., Ltd., Fluor affiliate, died December 31 in Niagara Falls, Ont.

Wallace J. V. Taylor, 59, part owner of Band Oil Co. and owner of Taylor Drilling Co. and Production Service, Long Beach, Calif., died December 27 in Long Beach. Taylor was a pioneer developer of Signal Hill field.

Joseph D. Davis, 72, Tulsa independent oil producer and chairman of the board of Producers Pipe & Supply Co., died January 8 in Tulsa. Davis was vice president of the old Magna Oil & Refining Co. before founding Producers Pipe & Supply and his producing firm, Joseph Davis Co.

I. R. (Ike) Minton, 47, vice president of Fleet Drilling Co., Ada, Okla., died January 7 after a heart attack. Minton joined Fleet in 1948. He had previously been with Fleetborn Corp. as field manager and later production superintendent in the old Fitz oil field.

THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND



"A Symphony in Steel"—A British Petroleum Company photograph.

THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND

APPLEBY-FRODINGHAM STEEL COMPANY • SAMUEL FOX & COMPANY LIMITED • UNITED COKE & CHEMICALS COMPANY LIMITED
STEEL PEECH & TOZER • UNITED STEEL STRUCTURAL COMPANY LIMITED • WORKINGTON IRON & STEEL COMPANY
DISTINGTON ENGINEERING COMPANY LIMITED • OWEN & DYSON LIMITED • YORKSHIRE ENGINE COMPANY LIMITED

THE UNITED STEEL COMPANIES LTD

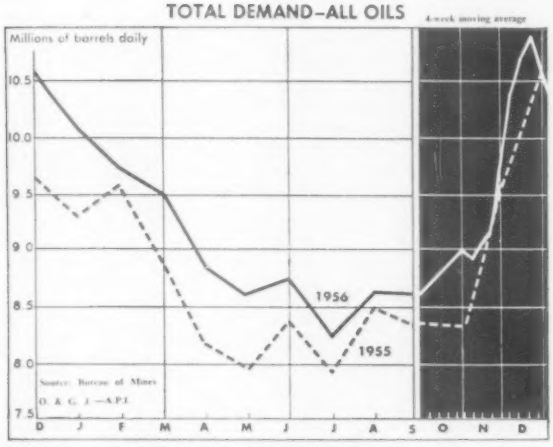
US 106

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,395,540	UP	77,315	UP	198,453
Crude stocks	264,241,000	DOWN	5,668,000	UP	2,208,000
Completions	1,014	DOWN	127	UP	10
Refinery runs	8,290,000	DOWN	105,000	UP	270,000
Gasoline stocks	186,808,000	UP	1,012,000	UP	17,796,000
Kerosine stocks	31,194,000	DOWN	605,000	UP	4,849,000
Distillate stocks	132,942,000	DOWN	1,867,000	UP	25,673,000
Residual stocks	42,731,000	UP	82,000	UP	3,012,000
Four-product stocks	393,675,000	DOWN	1,378,000	UP	51,330,000
Total imports	1,515,000	UP	124,800	UP	16,800

ALL TABLES AND CHARTS BASED ON A.P.I. REPORT ARE FOR WEEK ENDED DECEMBER 21 SINCE THE A.P.I. REPORT FOR DECEMBER 28 WAS DELAYED BY END-OF-YEAR HOLIDAYS.



Product Price Changes Hinge on Final Crude Prices and Product Demand

PRODUCT response to the crude-price increase has been slow. There are at least two reasons for the delay.

First, it has taken a full week for the crude-price pattern to reach a final form. Second, strength in the products market varies by areas as well as by products.

Early announcements of higher crude prices followed the pattern set by Humble Oil & Refining Co. First reports of new prices for the Mid-Continent area carried increases of $0.35 a barrel. Later announcements cut the boost to $0.25 a barrel.

There have been a few shifts in gravity differentials, particularly in areas of low-gravity, high-sulfur crude.

Higher postings for crudes produced along the Gulf Coast are based, at least in part, on export demand for crude during the European shortage.

Any refiner who is paying $0.35 a barrel more for crude will need at least an average of a cent a gallon more for products made from the crude. He'll need almost that much for a $0.25 raise.

Each refiner this week is trying to find the answer to the big question—Will product markets sustain increases large enough to cover the increased cost of crude?

Here is a summary of conditions in the Mid-Continent and on the Gulf Coast.

There have been no actual increases in spot prices at the refinery in the Mid-Continent area, but higher prices are expected.

Gasoline has been soft on the Group 3 market for many months and is expected to remain soft, at least through the winter and spring months.

Some formal refinery quotations in Group 3, based on posted tank-wagon prices, call for 11.50 cents a gallon for regular gasoline. Actual spot sales along the pipeline have been at 10.75 cents per gallon plus pipeline-transportation charges. There have been reports of even lower prices.

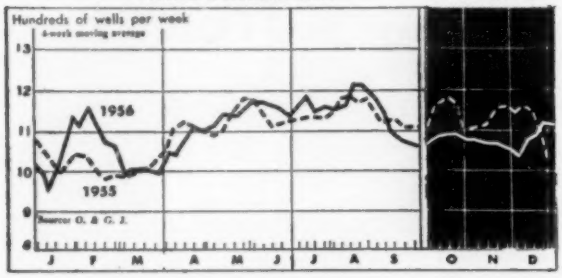
With spot sales at prices that are at least $0.75 cent under the normal based on tank-wagon prices, some branded marketers will be slow to raise tank-wagon prices until there is at least some indication that actual spot prices will move up also. When spot prices drop as much as 0.75 cent below normal, there is a definite shift from branded to unbranded gasoline. If tank-wagon prices move up a cent a gallon, spot prices will follow. The amount of pressure from surplus stocks will determine whether or not the new prices will hold.

Cargo prices for gasoline and distillates on the Gulf Coast have increased 0.25 cent a gallon. These are not expected to be final prices. Kerosine and distillate fuels will get additional increases over the next few weeks. Since no one wanted spot gasoline even at the old price, there is little chance that spot cargo sales will pick up any time soon.

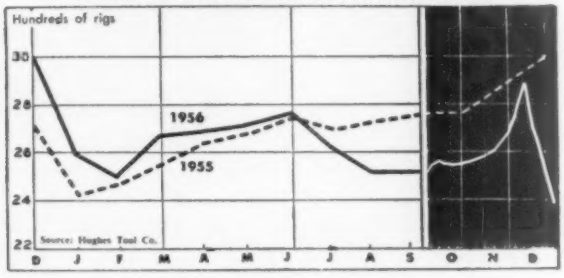
Heavy fuel is very strong on the Gulf Coast. Some suppliers still hold to a formal quotation of $2.40 a barrel for regular Bunker C, but no spot resid is moving at that price. The market is about $2.65 a barrel.

Natural gasoline increased 0.5 cent a gallon, effective January 7 for North Texas and January 9 for Group 3.

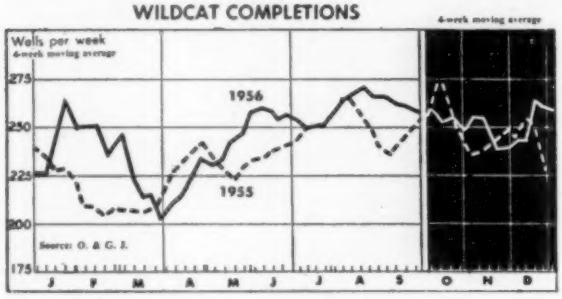
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	1-7-57	12-31-56	1-9-56
North Central and East	88	103	99
Southeast	34	34	37
Okla., Kans., Ark., Mo.	431	463	491
Louisiana	438	453	448
North and East Texas-Panhandle	379	408	443
Gulf and South Texas	243	252	261
West Texas-New Mexico	471	498	521
Rocky Mountain	201	223	258
Pacific Coast	110	115	132
Total United States	2,395	2,549	2,690
Western Canada	222	210	196

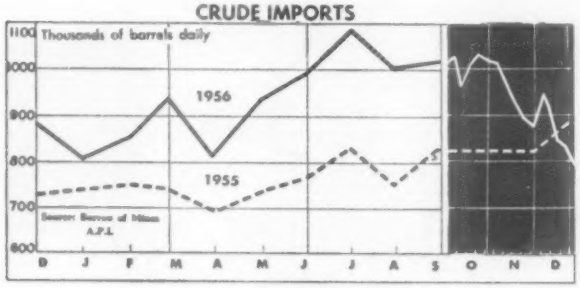
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED JANUARY 5, 1957

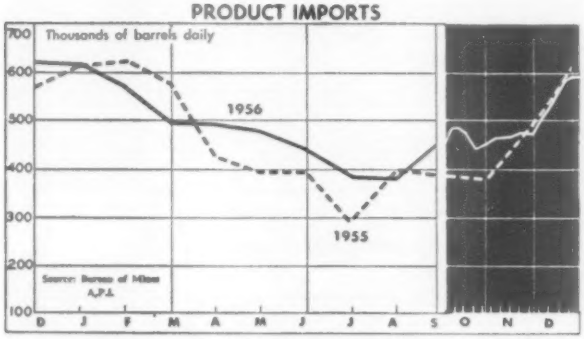
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Arkansas	13	10	0	3	37,925	13	9	0	0	0	1	1	0	0	0	1	1
California	47	36	0	11	230,878	47	40	0	0	0	10	10	0	0	0	10	10
Colorado	51	4	4	43	259,759	51	26	0	0	1	30	31	0	0	1	30	31
Illinois	0	0	0	0	0	0	74	0	0	0	0	0	0	0	0	0	0
Indiana	22	12	0	10	40,318	22	10	3	0	0	4	7	3	0	0	4	7
Kansas	86	40	4	*42	314,332	86	87	4	0	0	14	18	4	0	0	14	18
Kentucky	35	17	5	13	56,486	35	19	3	0	0	4	7	3	0	0	4	7
Louisiana	73	44	9	20	470,149	73	97	1	0	1	8	10	1	0	1	8	10
North	51	31	7	13	219,572	51	23	0	0	1	5	6	0	0	1	5	6
South	18	10	2	6	204,777	18	74	1	0	0	3	4	1	0	0	3	4
Offshore	4	3	0	1	45,800	4	...	0	0	0	0	0	0	0	0	0	0
Michigan	10	4	0	6	33,161	10	18	0	0	0	3	3	0	0	0	3	3
Mississippi	6	4	0	2	36,336	6	19	0	0	0	1	1	0	0	0	1	1
Montana	7	3	0	4	36,603	7	5	0	0	0	1	1	0	0	0	1	1
Nebraska	18	2	0	16	107,262	18	25	0	0	0	15	15	0	0	0	15	15
New Mexico	21	3	15	3	80,169	21	18	1	0	0	1	2	1	0	0	1	2
Northwest	21	3	15	3	80,169	21	3	1	0	0	1	2	1	0	0	1	2
Southeast	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0
North Dakota	6	4	0	2	37,663	6	7	1	0	0	2	3	1	0	0	2	3
Ohio	24	15	3	†6	60,876	24	24	0	0	0	0	0	0	0	0	0	0
Oklahoma	145	84	2	‡59	521,140	145	192	1	1	0	19	21	1	1	0	19	21
Pennsylvania-New York	10	0	5	5	45,924	10	5	0	0	0	2	2	0	0	0	2	2
Texas	423	234	20	169	1,647,490	423	455	16	1	4	99	120	16	1	4	99	120
Southwest (1 & 4)	44	24	1	19	188,842	44	92	4	1	0	18	23	4	1	0	18	23
Gulf Gulf (2 & 3)	37	18	4	15	83,753	37	59	1	0	2	6	9	1	0	2	6	9
East (5 & 6)	22	14	1	7	128,834	22	30	0	0	0	5	5	0	0	0	5	5
N. Central (7-B & 9)	145	55	3	87	442,647	145	134	9	0	2	49	60	9	0	2	49	60
West (7-C & 8)	139	105	3	31	656,405	139	128	2	0	0	14	16	2	0	0	14	16
Panhandle (10)	36	18	8	10	147,009	36	12	0	0	0	7	7	0	0	0	7	7
Utah	7	1	1	5	40,625	7	0	1	0	0	5	6	1	0	0	5	6
West Virginia	17	0	13	4	44,761	17	10	0	0	2	0	2	0	0	2	0	2
Wyoming	25	11	2	12	99,781	25	11	1	0	0	8	9	1	0	0	8	9
Miscellaneous (S. D.)	1	0	0	1	3,450	1	0	0	0	0	1	1	0	0	0	1	1
Total U. S.	**1,047**	528	83	436	4,205,088	1,047	1,154	**32**	2	8	228	**270**	32	2	8	228	270
Total previous week	1,141	572	82	487	4,865,408	...	...	22	2	10	194	228	...	...	...	...	...
Total Jan. 7, 1956	1,154	625	61	468	5,049,856	...	...	40	10	8	227	285	40	10	8	227	285
1957 total	1,047	528	83	436	4,205,088	1,047	...	...	...	...	...	...	...	...	...	...	...

Service wells included: *2, †3, ‡5.

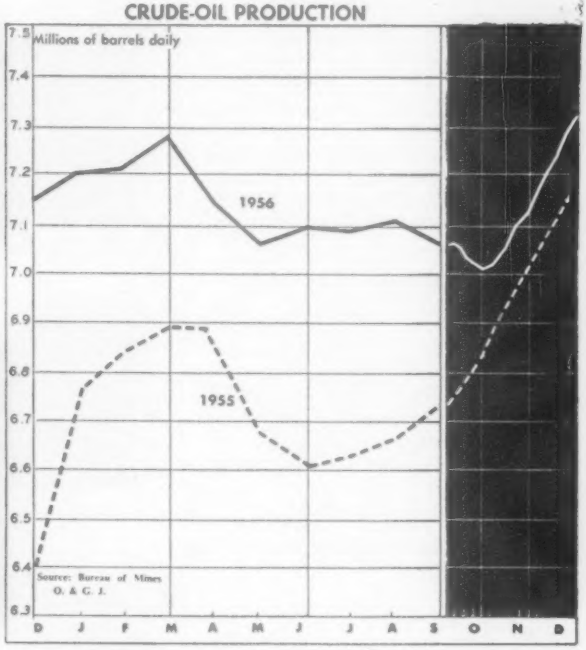
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

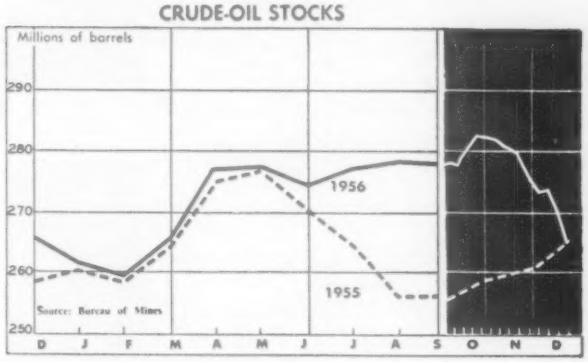


DAILY AVERAGE PRODUCTION FOR WEEK

	January 5, 1957			Dec. 29
	Crude oil	Lease condensate	Total	total
Alabama	11,440	.....	11,440	11,500
Arkansas	77,370	280	77,650	77,700
California	949,100	.....	949,100	950,400
Colorado	161,500	.....	161,500	157,000
Eastern	56,000	.....	56,000	52,000
Florida	1,250	.....	1,250	1,300
Illinois	237,300	.....	237,300	241,600
Indiana	33,100	.....	33,100	33,200
Kansas	†339,100	.....	†339,100	†343,100
Kentucky	48,300	.....	48,300	48,700
Louisiana	864,550	80,700	945,250	897,000
North	128,400	2,700	131,100	131,000
South	736,150	78,000	814,150	766,000
Michigan	27,100	.....	27,100	28,200
Mississippi	108,700	5,100	113,800	114,275
Montana	67,250	.....	67,250	66,950
Nebraska	37,850	.....	37,850	39,100
Nevada	100	.....	100	150
New Mexico	244,000	4,850	248,850	246,350
North Dakota	38,950	.....	38,950	38,700
Oklahoma	†631,600	.....	†631,600	†616,400
Texas	3,014,000	56,150	3,070,150	3,057,900
Dist. 1	55,500	575	56,075	56,075
Dist. 2	145,100	8,750	153,850	153,300
Dist. 3	431,650	26,000	457,650	456,500
Dist. 4	230,000	6,700	236,700	236,800
Dist. 5	39,500	550	40,050	40,050
Dist. 6	128,725	6,300	135,025	133,300
East Texas Field	207,375	.....	207,375	207,900
Dist. 7-B	160,700	75	160,775	159,060
Dist. 7-C	167,150	4,600	171,750	170,500
Dist. 8	1,136,575	1,450	1,138,025	1,129,500
Dist. 9	208,575	850	209,425	208,690
Dist. 10	103,150	300	103,450	106,225
Utah	9,000	.....	9,000	8,150
Wyoming	290,800	.....	290,800	288,450
Others	‡100	.....	‡100	‡100
Total U. S.	7,248,460	147,080	**7,395,540**	7,318,225
Change from prev. week, up			**77,315**	
Canada	†518,000	.....	518,000	†546,100
Total U. S. production, January 1-January 5				36,977,700 bbl.
Same period last year (crude plus cond.)				*35,985,435 bbl.

*Includes 620,500 bbl. condensate. †Week ended previous Monday. ‡S. Dakota.

CRUDE-OIL STOCKS

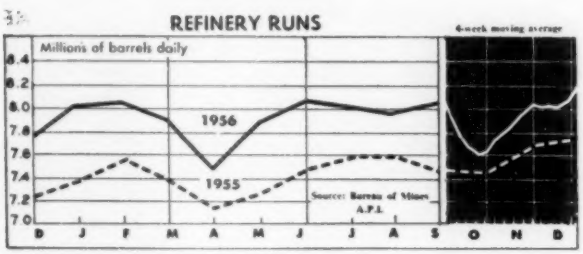


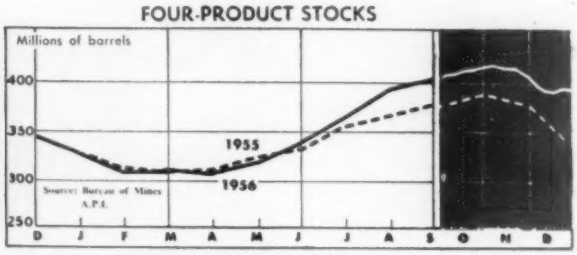
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

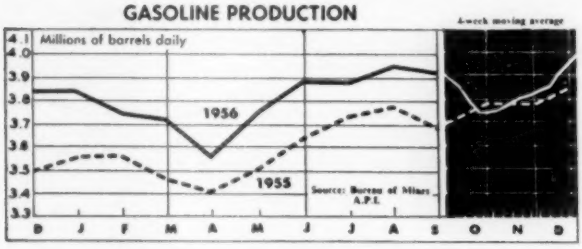
(Thousands of barrels)

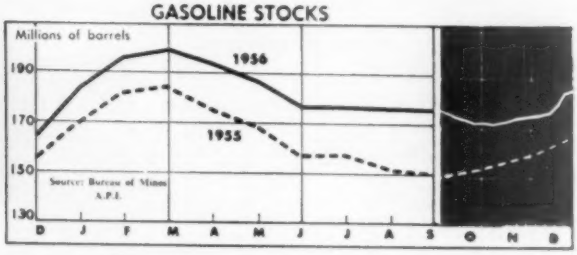
	12-29-56	12-22-56	12-31-55
Pennsylvania Grade	2,397	2,375	2,876
Other Appalachian	2,239	2,232	2,191
Illinois, Indiana, Michigan	10,833	11,223	9,440
Nebraska, North Dakota	2,095	2,344	2,093
Kansas	10,047	10,599	7,614
Oklahoma	23,433	22,986	22,066
Arkansas	2,880	2,815	2,086
Louisiana	19,001	18,987	15,971
North	4,402	4,306	2,505
South	14,599	14,681	13,466
Mississippi	2,620	2,649	2,786
New Mexico	7,901	8,454	7,599
Texas	117,425	120,730	124,235
East Texas proper	9,057	8,957	9,559
West Texas	54,224	57,414	59,027
Texas Gulf	22,576	23,803	24,447
Other Texas	31,568	30,556	31,202
Wyoming	16,637	16,417	15,430
Other Rocky Mountain	6,395	6,668	6,311
California	28,170	28,701	28,471
Foreign	†12,168	12,729	12,864
Total	264,241	269,909	262,033

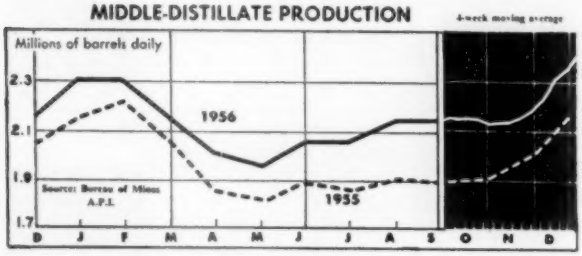
*Bureau of Mines. †Includes 2,941,000 bbl. in California.

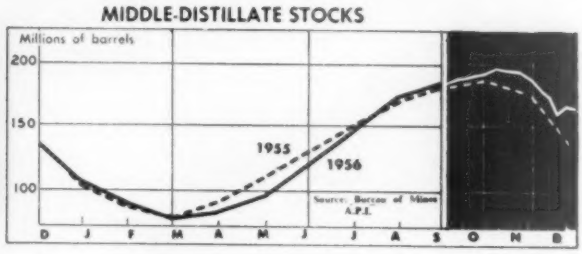


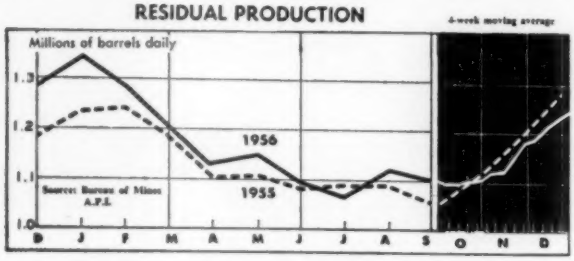


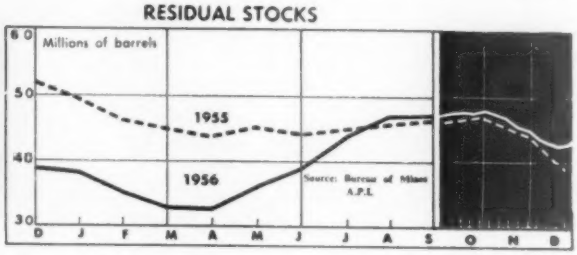

GASOLINE PRODUCTION
Millions of barrels daily
4-week moving average
1956
1955
Source: Bureau of Mines A.P.I.
D J F M A M J J A S O N D




MIDDLE-DISTILLATE PRODUCTION
Millions of barrels daily
4-week moving average
1956
1955
Source: Bureau of Mines A.P.I.
D J F M A M J J A S O N D




RESIDUAL PRODUCTION
Millions of barrels daily
4-week moving average
1956
1955
Source: Bureau of Mines A.P.I.
D J F M A M J J A S O N D



A.P.I. REFINERY REPORT, JANUARY 4, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production— Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, January 1956 Daily avg. runs	Daily average production— Gaso.*	Kero.	Dist.	Resid.
East Coast	1,225	505.9	57.7	336.9	240.9	40,952	12,998	51,111	11,840	1,132	483.0	41.6	300.7	259.6
Appalachian:														
District 1	105	40.3	6.6	22.7	8.6	4,989	632	3,119	465	105	44.7	5.6	27.1	11.5
District 2	106	57.2	8.9	22.6	14.7	3,034	561	1,096	285	104	52.3	7.9	18.4	17.3
Ind., Ill., Ky.	1,507	795.3	83.3	349.1	199.6	32,940	6,368	20,425	5,423	1,492	761.7	75.9	336.3	222.9
Minn., Wis., Dak.	100	49.1	3.4	28.3	7.4	7,313	1,464	7,728	201	87	41.4	9.9	18.5	10.6
Okla., Kans., Mo.	715	419.6	17.0	194.1	41.6	17,335	1,434	12,537	1,502	708	407.1	17.1	190.1	43.7
Inland Texas	281	203.7	13.0	49.3	21.7	7,223	621	1,861	1,881	278	192.5	8.3	53.5	26.8
Texas Gulf Coast	1,975	904.6	132.4	549.4	252.0	25,811	2,969	11,297	5,648	1,908	895.3	138.3	527.5	251.2
La. Gulf Coast	716	347.9	68.8	197.4	63.7	12,018	2,342	5,629	1,787	697	313.0	62.7	175.7	58.1
N. La. and Ark.	108	45.4	10.4	24.6	6.3	4,733	1,015	2,030	280	94	36.7	8.7	21.3	8.6
Rocky Mountain:														
New Mexico	25	12.7	0.6	4.9	3.7	496	9	120	71	22	11.5	0.7	3.3	3.2
Other Rocky Mtn.	276	133.4	5.1	67.6	30.0	6,057	417	2,769	911	269	131.2	4.9	66.6	44.0
West Coast	1,151	514.9	6.9	220.0	359.1	23,907	364	13,220	12,437	1,127	472.5	3.6	184.1	386.8
Jan. 4, 1957	8,290	4,030.0	414.1	2,066.9	1,249.3	186,808	31,194	132,942	42,731	8,023	3,842.9	385.2	1,923.1	1,344.3
Dec. 28, 1956	8,395	4,025.1	392.3	2,080.7	1,286.3	185,796	31,799	134,809	42,649	.....	.....	.....	.....	.....
Jan. 6, 1956	8,020	3,882.7	349.1	1,928.7	1,270.7	169,012	26,345	107,269	39,719	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (88 octane)	10.75-11.50
Premium (96 octane)	12.50-13.25
Gulf Coast (cargoes for coastwise or export movements):	
★ Regular (90 octane)	11.25-11.50
★ Regular (92 octane)	11.50-11.75
★ Premium (97 octane)	13.00-13.25
★ Premium (98 octane)	13.25-13.50
California (rack):	
Regular (84 octane)	12.6-13.1
Premium (93 octane)	13.6-14.1
Premium (96 octane)	14.6-15.1
Caribbean area (cargoes):	
Regular (87 octane)	10.00
Premium (93 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
★ Grade 26-70	5.0
Breckenridge:	
★ Grade 26-70	4.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.25-10.50
Diesel oil (58 d.i. and above)	9.875-10.125
Distillate No. 1	9.875-10.125
Distillate No. 2	9.25-9.50
Gulf Coast (cargoes):	
★ Kerosine 41-43	10.25-10.50
★ Distillate No. 2	9.75-10.00
New York Harbor (barges):	
Kerosine 41-43	11.25
Distillate No. 2	10.65
Diesel fuel, 48-52 d.i.	10.95
Caribbean area (cargoes):	
Distillate No. 2	9.25

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$2.30-2.50
Gulf Coast (cargoes):	
★ Bunker C fuel	$2.65-2.80
New York Harbor (barges):	
Bunker C fuel	$3.05
Caribbean (cargoes):	
Bunker C	$2.40
California (rack):	
★ Bunker C fuel, Los Angeles	$2.60-2.75

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	24
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	20.75
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	27
200 vis. neutral (180 at 100°), 25 p.t.	25

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.42				
15-15.9	2.46				$1.89
16-16.9	2.49				1.94
17-17.9	2.53				1.99
18-18.9	2.57				2.04
19-19.9	2.60				2.09
20-20.9	2.64	$2.75		$2.62	2.14
21-21.9	2.68	2.77		2.64	2.19
22-22.9	2.72	2.79		2.66	2.24
23-23.9	2.76	2.81	$3.44	2.68	2.29
24-24.9	2.80	2.83	3.46	2.70	2.34
25-25.9	2.84	2.85	3.48	2.72	2.39
26-26.9	2.88	2.87	3.50	2.74	2.44
27-27.9	2.92	2.89	3.52	2.76	2.49
28-28.9	2.97	2.91	3.54	2.78	2.59
29-29.9	3.02	2.93	3.46	2.80	2.59
30-30.9	3.07	2.95		2.82	2.63
31-31.9	3.13	2.97		2.84	2.67
32-32.9	3.19	2.99		2.86	2.71
33-33.9	3.25	3.01		2.88	2.75
34-34.9	3.31	3.03		2.90	2.79
35-35.9	3.36	3.05		2.92	2.83
36-36.9	3.40	3.07		2.94	2.87
37-37.9	3.43	3.09		2.96	2.89
38-38.9		3.11		2.98	2.91
39-39.9		3.13		3.00	2.93
40 and up		3.15		3.02	2.95

*Includes Oklahoma, most of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low cold test Gulf Coast. ‡Sour.

Effective dates: California, November 19, 1956; east of California, January 3-Janaury 10, 1957; Pennsylvania Grade, August 16, 1956.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	4.68
Middle District	4.50
Southwest Pennsylvania	4.21
West Virginia	4.03
Buckeye Grade	4.07
Zanesville Grade	3.15
Illinois Basin	2.90
Canada:	
Leduc-Woodbend (flat prices D-2, D-3)	2.60
Redwater (Alta.) D-3	2.49
Smiley-Viking (Sask.)	2.26
Pembina	2.52

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.40
San Joaquin, 41°-41.9°, Puerto La Cruz	3.04
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26.5°-26.9°, Amuay*	2.40
Quiriquire, 16.5°-16.9°, Caripito	2.40
Lagunillas heavy, flat, Amuay or Las Piedras*	2.33
Bachaquero, 16.5°-16.9°, Las Piedras*	2.18

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
Iranian, 34.0°-34.9°, Bandar Mashur	1.91
Iranian, 34.0°-34.9°, Abadan	1.86
Iraq, 36.0°-36.9°, Fao	1.87
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.72
Qatar, 39.0°-39.9°, Umm Said	2.06
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

TANKER RATES PER LONG TON
(Latest reported spot fixtures)

★ N.W.I.-U.S.N.H., dirty (USMC +147.5%)	$6.68
★ N.W.I.-U.K., clean (Scale+382.5%) (156s. 10d.)	21.90
★ N.W.I.-U.K., dirty (Scale+275%) (121s. 10d.)	17.01
★ Gulf-U.K., clean (Scale+382.5%) (185s. 4d.)	25.88
P.G.-France, dirty (Scale+350%) (362s. 8d.)	50.65
★ P.G.-Buenos Aires, dirty (USMC +222.5%)	43.38

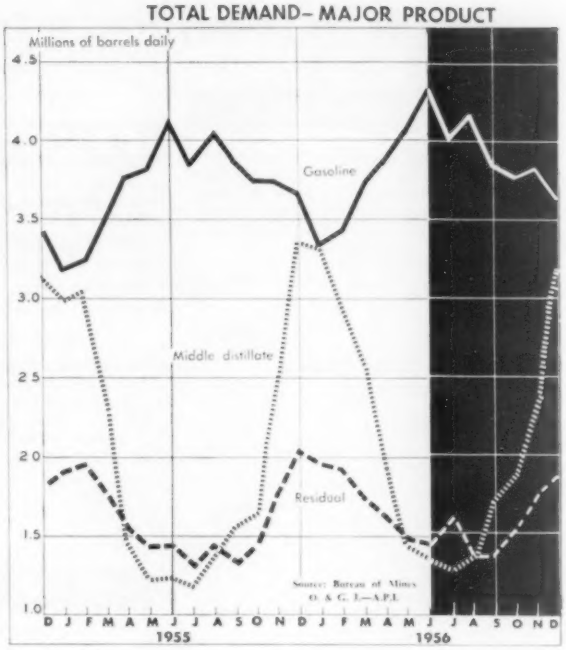
SUPPLY AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

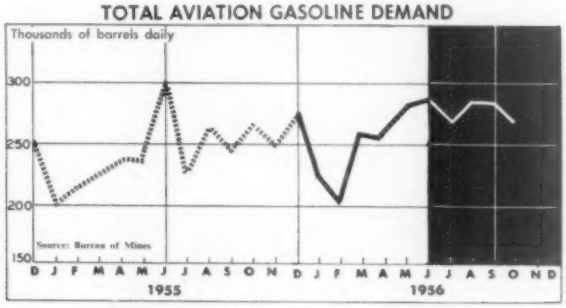
	Total demand	Refinery production	Stocks end of period†
GASOLINE			
December 1956*	3,643	3,954	186,000
November 1956*	3,835	3,822	175,400
October 1956	3,970	3,727	172,798
January 1956	3,335	3,843	183,905
December 1955	3,679	3,846	165,433
KEROSINE			
December 1956*	474	381	31,000
November 1956*	390	376	34,600
October 1956	294	356	35,667
January 1956	569	385	21,310
December 1955	605	395	26,770
DISTILLATE			
December 1956*	2,620	1,985	131,000
November 1956*	2,004	1,819	153,500
October 1956	1,521	1,772	158,871
January 1956	2,755	1,923	86,141
December 1955	2,768	1,765	111,333
RESIDUAL			
December 1956*	1,875	1,240	42,500
November 1956*	1,746	1,181	44,400
October 1956	1,532	1,082	48,400
January 1956	1,980	1,344	38,247
December 1955	2,036	1,286	39,174

*Preliminary. †Thousands of barrels.

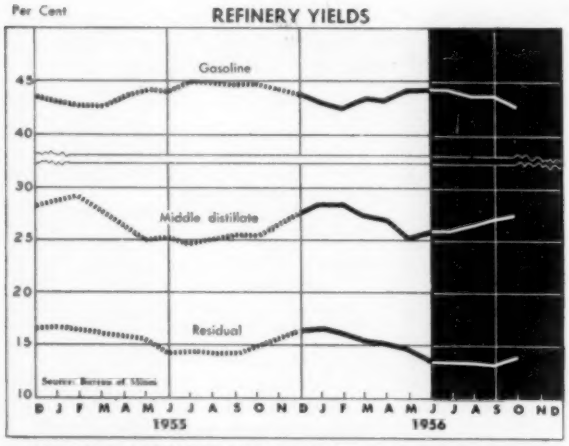
TOTAL DEMAND–MAJOR PRODUCT



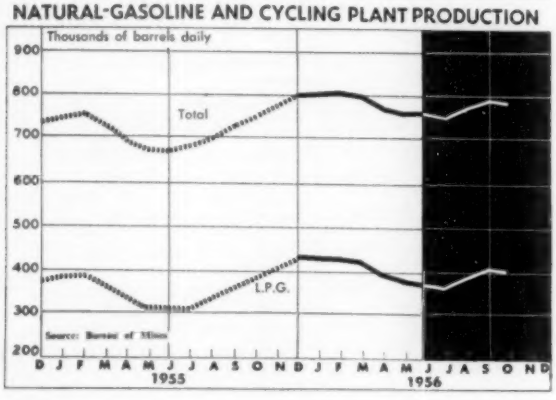
TOTAL AVIATION GASOLINE DEMAND



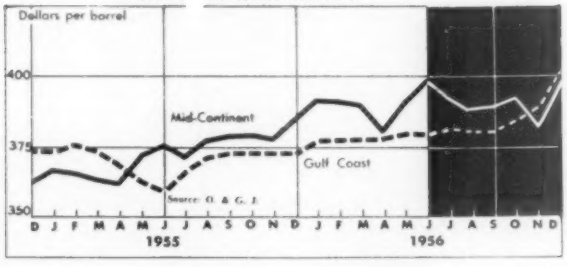
REFINERY YIELDS



NATURAL-GASOLINE AND CYCLING PLANT PRODUCTION



REFINERY REALIZATION



REFINERY REALIZATION

	Dec.* 1956	Nov.* 1956	Oct. 1956	Dec. 1955
Mid-Continent	$3.98	$3.82	$3.87	$3.85
Gulf Coast	4.03	3.89	3.79	3.73

*Preliminary.

Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel oil, and residual as published in The Oil and Gas Journal.

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FOR SALE at Ponca City—2—used #12 Sweetland filter presses, 36 leaves covered with 200 Mesch monel screens, 60 additional leaves and some new repair parts—Cities Service Oil—Patridge—Bartlesville, Oklahoma.

FOR SALE—1—FAC-19 SS Pur-O-Cell filter, serial #FC-35637, new 1953—$850.00. 1—FAC-10 steel—d i t t o—serial #FC-33717, new 1951—$350.00. 3—Model CF Sealless magnetic drive Chempumps, new 1954, each $250.00. Used stainless steel, 2" pipe, valves and fittings—50% new. 1 each type CPS 2 and 3 Lapp Pulsafeeder Chemproportionating pumps—new 1954—$500.00 and $750.00. Cities Service Oil—Patridge—Bartlesville.

ITEM #1—2—75 H.P. G. E. Tri Clad 440 V Motors, Frame #6324, Speed 880 RPM with controls. Item #2—1 Complete Transformer Bank including contacts and arresters, etc., 3—G. E. 100 KVA Transformers, Type H, Form K. R. Voltage Rating, 7200/240/480. Item #3—1—60 H.P. Reda Deep Well Pump, with controls for 220 and 440 V., 550' cable, new recently. Item #4—1—Aldrich Pump for Water Flood, 6" Stroke Triplex inverted Fig. 3800D equipped with $2^3/_8$" Porcelain plungers, belted for above motors. Item #5—1—4' x 8' National Filter. Marvin E. Boyer Oil Company, P. O. Box 35, Iola, Kansas.

14 horizontal welded steel tanks, 10' dia. x 40' long, dished heads, thickness $^3/_8$" throughout, 25,000 gal. each, used for aviation gasoline.

4—55,000 barrel closed riveted steel tanks.
1—55,000 barrel closed welded steel tank.
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Number of propane and butane tanks from 2,500 to 20,000 gal.

A. O. Smith and Pfaudler blueglass lined welded steel tanks, $^3/_8$" shell, heads $^1/_2$" are dished from 5,000 to 25,000 gallons. Bolted type steel tanks 500 barrel to 10,000 barrels.

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7" O.D. 9187' 23# 8 Rd Thrd N-80 LT&C R-2 & 3
7" O.D. 6585' 23# 8 Rd Thrd J-55 ST&C R-2
7" O.D. 1550' 26# 10 V Thrd Grade D LT&C R-2

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127' TYPE B OIL WELL Jackknife Derrick with five-sheave crown, 10' x 42' x 24' Split Type Sub-Structure, steel flooring. Price, $7,500. IVERSON SUPPLY COMPANY, Kermit, Texas. Phone 3491.

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6—Brown fintube exchangers, 300# 140 sq. ft. 4-6 chrome.
1—5' x 96' tower, 40 tray, 135# WP.
1—6' x 34' Vacuum tower, 150#.
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3—Welded tanks, 10' x 40', 5' x 20'.
2—8½' x 25' Tanks 50#
1—Ethyl lead plant.
2—Convection furnaces, 20 MIL BTU/hr.
12—Welded storage tanks, 5,000, 2,000, 1,000 bbl.
8—Hi-vol pumps, 10 x 7 x 18, 10 x 6 x 12, 6 x 4 x 12, 6 x 3 x 8.
4—Steel Bldgs., 20 x 20, 20 x 40.
1—BS&B O&G separator, 10.7 mcf/day. Large Selection of Series 15, 30 Steel Valves, 1" to 8"
Approximately 15,000 ft. Schedule 40, 80 pipe, 2" to 8".

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm—2,000' hd, 735 gpm—3,100' hd.
5 Pacific SVTB, 612 gpm—600' hd, 324 gpm—480' hd, 308 gpm—516' hd, 193 gpm—389' hd.
1 Pacific HVTB (unused) 1270 GPM—408' Hd.

IN STOCK

HEAT EXCHANGERS

3—Kellogg Adm. Fltg. Hd. 2200, 1800 Sq. Ft., 315#
4—Kellogg Steel Fltg. Hed. 800, 650, 500 Sq. Ft.

COMPRESSORS

1 Worth LTC-6 800 hp.
2 Clark RA-5 500 hp.
3 Penn Comps 100 CFM 500 lbs. 385 CFM 160 lbs.

MISCELLANEOUS

6—Bird Centrifugals 32 x 50, 24 x 38, 18 x 28.
5—Sweetland Filters No. 12, No. 10, No. 7, No. 5.
4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8.
6—Adm. 785, 742, 425 sq. ft. ht. exch.
30—304 SS shell & tube condensers 100-1000 sq. ft.
Lab Petro-Chem furnace 50,000 BTU/hr.
9—3' x 10' 410 SS Sheets.
Tremendous selection stainless steel and steel valves 1½"-6".
BJ hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.
Goulds 16" pump, 10,500 gpm, 135' hd.

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- 2,500,000 bbl. Storage Tanks from 500 to 100,000 bbls.
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Diamond 3-4890

CASING FOR SALE: 176' of 7⅝ OD, 26.40#, J-55, 8rd, ST&C, SS. 506' of 8⅝" OD, 28#, H-40, 8rd, ST&C, SS. 267' of 8⅝" OD, 32#, J-55, 8rd, ST&C, SS. 434' of 8⅝" OD, 36#, J-55, 8rd, ST&C, SS. 1075' of 8⅝" OD, 36#, J-55, 8rd, LTC, SS. 706' of 9⅝" OD, 32.30#, H-40, 8rd, ST&C, SS. May be inspected Canyon Trucking Corp.'s yard, Midland, Texas. PIPE Inc. P. O. Box 4137, Corpus Christi, Texas. Phone TU 4-4029.

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Electrically operated, of the following specifications:

Chicago Pneumatic Simplate Valve Gas Compressor, Serial No. 55045.
Size 12—12 x 7 Y D E
Direct connected to Allis-Chalmers Induction Motor NENA
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Unit can be inspected at the Generating Plant of the
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Aetna Standard Double-End Cut-Off Machines

Capacity from 3" to 8¾" O.D.
Cutting speed from 60 to 240 feet per minute
Two machines—one left hand, one right hand.
With collets in ¼" multiples from 3" to 7¾" for each machine.
New—1944—excellent machines.
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1500 FAILING, 42' mast, 28' x 3½" kelly, on L-180 International, less pump and pipe. Fred Butler, Box 481, Pueblo, Colo.

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10,000 FEET used 4½ in. drill pipe, good for shallow drilling. $1.25 per foot. Fadem Pipe and Supply, 201 Mid States Bldg., Tulsa, Okla., phone GI 7-8068.

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HEAT EXCHANGERS:
Admiralty and Steel Tube capacity 240 to 1500 sq. ft.

RE-BOILERS High Pressure

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Admiralty tube, capacity 200 to 650 sq. ft.

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WICHITA, KANSAS

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GEOLOGIST—Independent producing company with expanding drilling activity in Mid-Continent area needs graduate geologist as chief of staff in non-administrative capacity. Several years major company experience desirable, prefer age 30 to 40. Splendid opportunity for man eager for a participation arrangement. Give full qualifications, experience, and photo with first letter. All replies held confidential. Box J-883, The Oil and Gas Journal, Tulsa, Oklahoma.

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for pipeline construction equipment for New York sales area. Salary commensurate with experience and ability. Write full details of qualifications and experience to

BOX J-866,
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WRITE

Giving complete address, age, marital status, education and details of previous experience

BOX 308-S
RADIO CITY STATION
NEW YORK 19, NEW YORK

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Independent Oil Company has opening for experienced, aggressive combination geologist and landman. Must have thorough understanding of geological and land matters in Mid-Continent area and be prepared to handle full exploration program. Age limit 40. This is salaried position with excellent pay. In replying, give past employment record and educational background. All replies confidential. Reply

Box J-873, The Oil and Gas Journal,
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for FIELD and DEVELOPMENT WORK

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Experience background should include drilling, servicing and secondary recovery in oil well field.

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(AGE 30 - 38)

Career employment opportunities with major integrated United States Oil Company for South America. Openings now exist in an expanding geological organization at levels requiring from 6 to 10 years experience in surface or sub-surface geology. Salaries including bonus from $16,500 to $18,000. Liberal employee benefits and home vacations with travel expenses. Interested experienced geologists with B.S., M.S., or Ph.D. degree in geology are invited to send complete resumes to the address given below. Interviews will be arranged for qualified candidates. All replies confidential.

BOX 480

A-21

New York 19, New York

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Local Manager by independently owned natural gas transportation and distributing company. Prefer man between 40 and 50 years of age with general experience. Must know field gathering, transportation and distribution; must have initiative and general supervisory ability. Salary and opportunity commensurate with capability.

Box J-872, The Oil and Gas Journal,
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Giving age, complete address, marital status, education and details of previous experience.

BOX 308-R

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NEW YORK 19, N. Y.

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Well established pipe line contractor has big opportunity for chief engineer preferably with previous experience in South America. Working knowledge of Spanish desirable with technical background in petroleum, petroleum products, natural gas transportation, and station design. Please send all data to

BOX J-886,

THE OIL AND GAS JOURNAL,

TULSA, OKLAHOMA.

HELP WANTED

REFINERY ENGINEER — Process engineering position with large independent company operating in Mid-Continent area. One to five years experience desired. State qualifications and give salary requirements. Box J-877, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER — Independent oil company has opening for petroleum engineer with two to four years experience to be located in Tulsa, Oklahoma. Send resume of education and experience to Box J-884, The Oil and Gas Journal, Tulsa Oklahoma.

GRADUATE Petroleum Engineer at least 4 years drilling production and reservoir experience with working knowledge subsurface interpretations wanted by independent producer for position Midland or Wichita Falls. Please submit full resume education qualifications and salary desired. All information confidential. Box J-875, The Oil and Gas Journal, Tulsa, Oklahoma.

ANDERSON-PRICHARD Oil Corporation has an opening in its Reservoir Engineering Section for a Junior Petroleum Engineer. Initial work location will be Oklahoma City. Applicants must have engineering degree; some field experience would be desirable. Please furnish a brief personal history including education and professional experience. All replies confidential. Address: Industrial Relations Department, Anderson-Prichard Oil Corporation, Liberty Bank Building, Oklahoma City, Oklahoma. Attention: Mr. D. F. Tver.

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TWO SALES ENGINEERS to be located in South Louisiana. Must have either oil field production or sales experience. Salary open, send resume of education and experience to Box J-857, The Oil and Gas Journal, Tulsa, Oklahoma.

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs. $5.00 cash. OIML Co., Box 2603, Tulsa, Okla.

GAS ENGINEER—Graduate engineer with four years or more experience and background in gas transmission engineering and operations—design of compressor station, pipeline, and related facilities—for position of staff engineer, chief engineer's office of large natural gas transmission company. Location area—Pacific northwest states. A considerable opportunity for development exists in this position. Salary commensurate with qualifications. Replies will be held confidential. Write Box J-843, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER. Rapidly expanding independent producing company has immediate opening in Canadian Division for Petroleum Engineer with 1 - 3 years drilling experience. Send resume of education, experience and salary desired to Box J-853, The Oil and Gas Journal, Tulsa, Oklahoma.

CHIEF CHEMIST with at least six years refinery experience. Must be aggressive and have some asphalt experience, for an 18,000 BPD Independent Texas Refinery. Also Chemist with at least three years experience to handle gasoline research as well as other light oil products. Apply Box J-776, The Oil and Gas Journal, Tulsa Oklahoma.

GAS ENGINEER—Leading independent oil company has opening for graduate engineer under 32 with general knowledge of construction, operation, and maintenance of gasoline plants, gathering systems, compressor stations, gas pipe lines and related facilities. Also knowledge of process engineering. Dallas, Texas, or Shreveport, Louisiana, location. Write full particulars as to personal background, education, experience, and salary requirements to P. O. Box 3053, Dallas, Texas, and enclose small photo.

HELP WANTED

PROCESS ENGINEER with thorough technical training and minimum background of eight years refining and hydrocarbon processing experience with special emphasis on catalytic reforming and petrochemicals. Send complete record of education, experience, and minimum salary expected. Write Box J-867, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

PRODUCTION ENGINEER: Desires responsible position with aggressive independent. 11 years experience engineering and production with major company West Texas, 2 years wildcatting Rocky Mountains. Married, 36 yrs. of age, B.S. in Petroleum Engineering. Box J-856, The Oil and Gas Journal, Tulsa, Oklahoma.

PIPELINER, graduate engineer, 38, 10 years experience from bottom up. Crude, products, operations stations, terminals, hydraulics, design, construction, planning and development, economic reports, vast field supervision. Desires Superintendent or Key Engineering position Mid-Continent, Rocky Mountain, or Canada. Employed. Box J-860, The Oil and Gas Journal, Tulsa, Oklahoma.

DISTRICT GEOPHYSICIST with major company desires position with smaller organization to supervise geophysical activities: correlate magnetic, gravity, and seismic results, and make independent interpretations of seismic data. Box J-868, The Oil and Gas Journal, Tulsa, Oklahoma.

DESIRE OPPORTUNITY with independent oil or gas producing company. Married, age 34, 12 years varied experience including glycol injection dehydration production and well completion. Box J-871, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER, nine years experience; production administration, reservoir engineering, valuation. Desire management position with aggressive organization analyzing exploratory and development programs, and conducting reserve estimates and appraisals. Presently employed. Consider Mid-Continent or Rocky Mountain location. Box J-870, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST: Ten years experience including seismic party chief, review, supervisory work, seeks permanent position with opportunity advancement. Good Spanish; work anywhere Western Hemisphere. Box J-879, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL ENGINEER with varied experience (also Field Engin.) Nat.-Gas Transmission line, City Distribution. Constr. and mainten., etc., desires change, U.S.A. or abroad. Fluent German, good French and Spanish. At pres.: Division-Superintendent. Box J-881, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Desires responsible position with an independent or drilling Co. in Dallas. Seven years experience, sub-surface geology, drilling production, workover in N.W. and S.E. New Mexico, West and West Central Texas. Single, free to travel. Box J-882, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION FOREMAN: Seventeen years oil field experience. Presently employed in management capacity. Prefer Mid-Continent but other locations considered. Joe Charles, R.F.D., Pawhuska, Okla.

MACHINE SHOP SUPERINTENDENT: Twenty-four years experience with major oil companies, administrative, heavy rig repair and maintenance welding, salvage and boiler shops. Finest of references. Available immediately for foreign or domestic position. Box J-885, The Oil and Gas Journal, Tulsa, Oklahoma.

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PROVEN OR SEMI-PROVEN Leases or farmouts with drilling obligation wanted in South Texas Districts 1, 2, or 4. Box J-862, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL COMPANY offers attractive drilling deal or farmout. Good opportunity for tax money. Box J-811, The Oil and Gas Journal, Tulsa, Oklahoma.

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WANTED oil and gas production, royalties, reasonably priced. Unlimited finances available. Prompt action. Send full details. Box 231, Scarsdale, N. Y.

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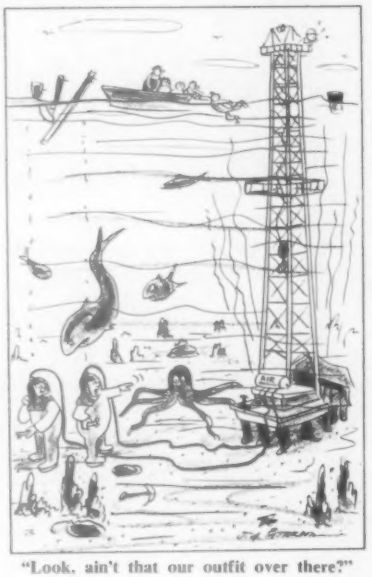

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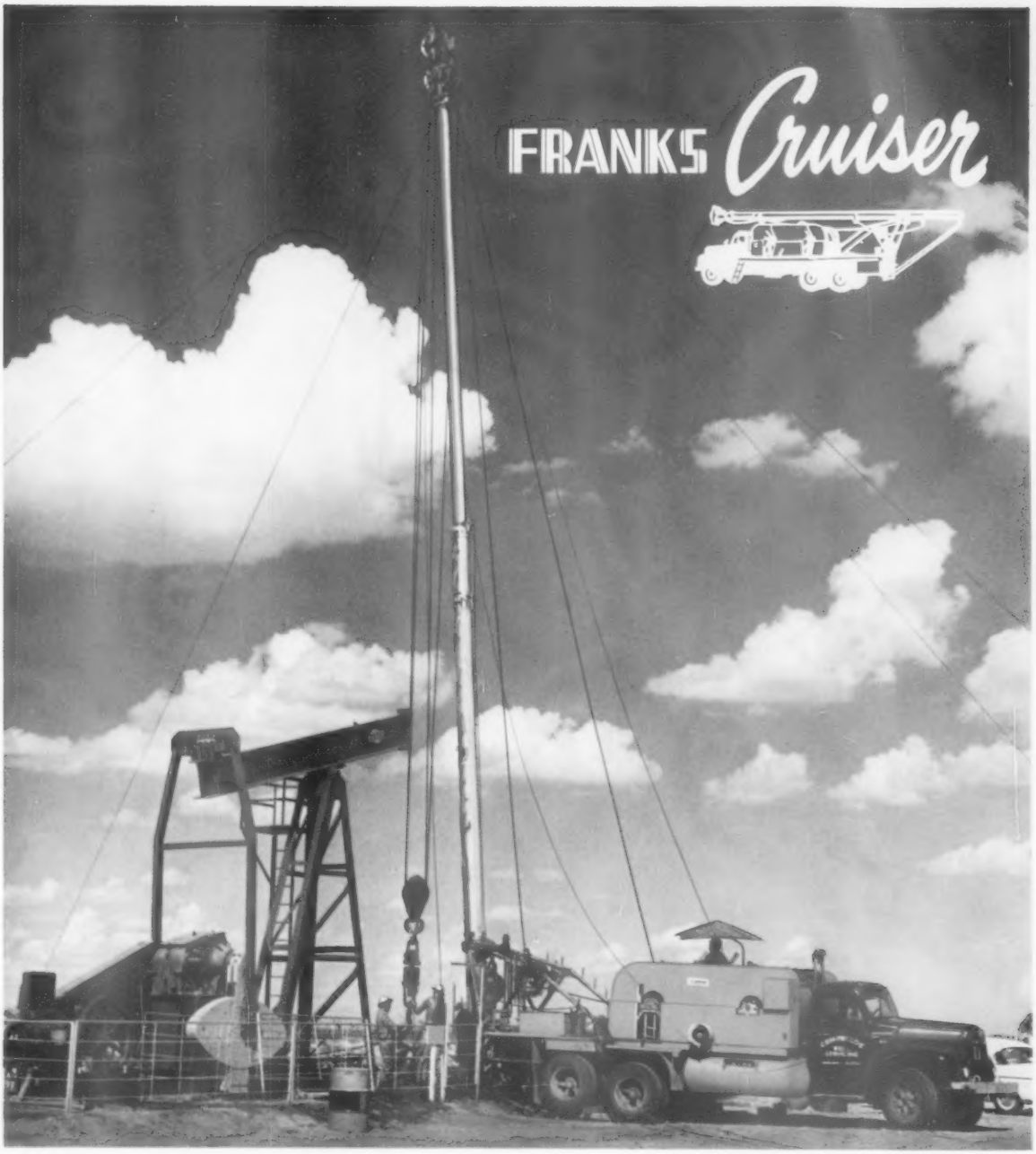

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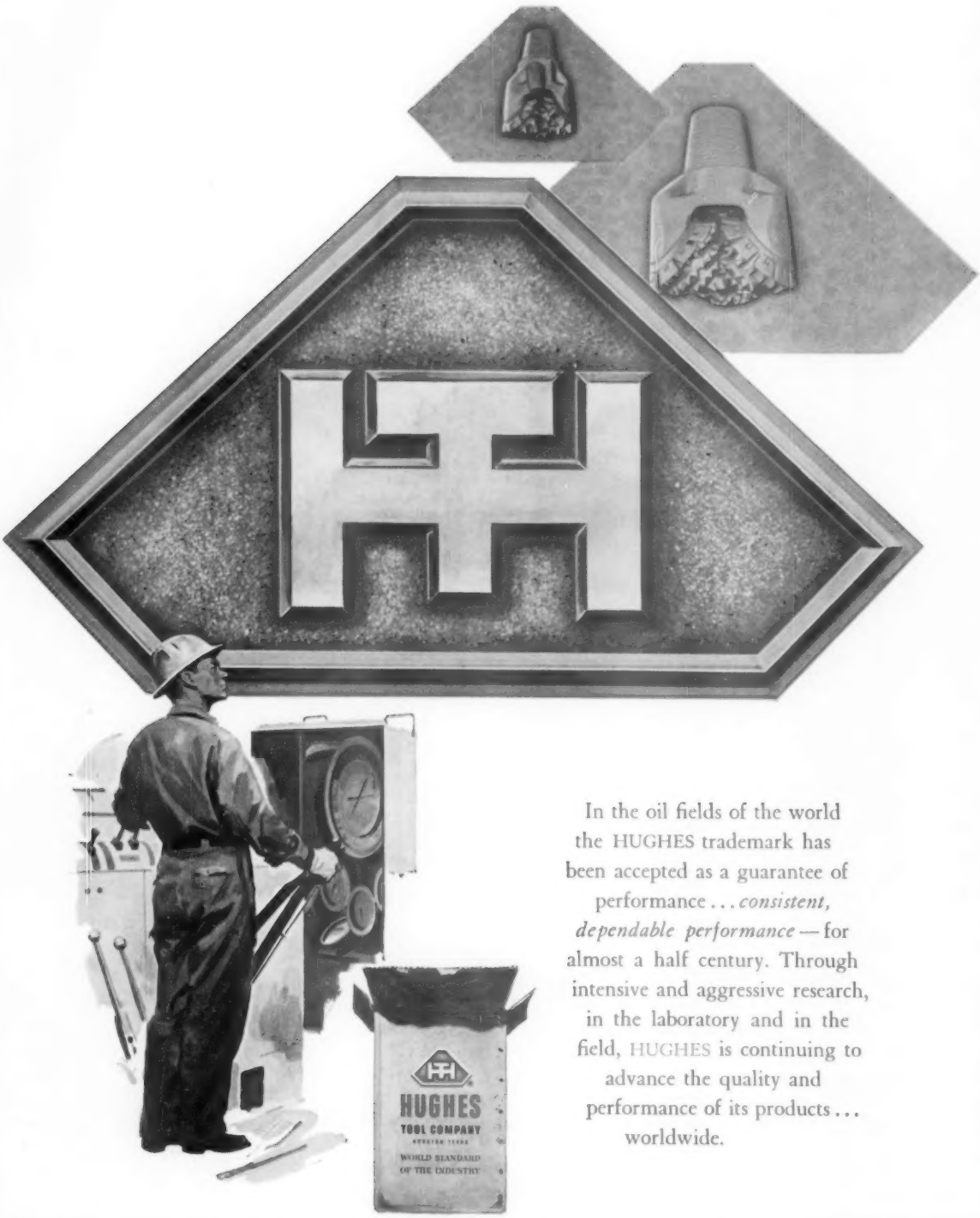

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